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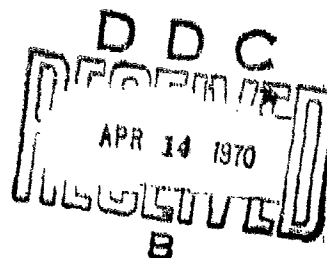
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Technical Report  
March 1970



COMPUTERIZED RADC RELIABILITY NOTEBOOK  
(GE/645/TSS/BASIC)

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Rome Air Development Center  
Air Force Systems Command  
Griffiss Air Force Base, New York

Prepared by the  
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COMPUTERIZED RADC RELIABILITY NOTEBOOK  
(GE/645/TSS/BASIC)

George W. Lyne

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FOREWORD

This in-house report was prepared by the Reliability Engineering Section, Reliability Branch, Reliability and Compatibility Division, Rome Air Development Center, Griffiss Air Force Base, New York, under Project 5519. The project engineer and author of this report was Mr. George W. Lyne (EMNRR).

Acknowledgement is given to members of the Reliability and Compatibility Division for assistance in the development of the input and output formats of the computer programs herein.

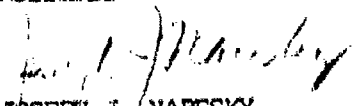
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# ABSTRACT

Computer programs which enable the reliability engineer to mechanically apply the "RADC Reliability Notebook," Volume II, September 1967, in obtaining the failure rate of piece parts are presented.

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## SECTION I

### INTRODUCTION

#### 1. OBJECTIVE

The purpose of this report is to provide the reliability engineer with a computerized version of the "RADC Reliability Notebook" (Vol.II), September 1967.

Basis of this effort was the number of inquiries to RADC for a computerized version of the Notebook since publication.

#### 2. RESULTS

A library of computer programs, written in basic language for the General Electric 645/Time-Sharing System, which provide the reliability engineer with a mechanical means of applying the "RADC Reliability Notebook" in obtaining catastrophic failure rates for part-types covered by the Notebook. These programs provide the engineer with:

- A. Short analysis response time resulting in cost savings
- B. Capability of obtaining failure rates of a given part for various stress conditions
- C. Repeatability and minimization of error because of computer assessment.

#### 3. LIBRARY CONTENT

A listing of the computer programs contained herein is presented in the table of contents. Computer listings and examples of the implementation of the programs are presented in Sections I and II of this report.

Following is a list of part categories covered in the Notebook which are not covered herein. This is because the failure rate prediction techniques did not lend themselves to computerization or the math models were not available, and the GE/645/TSS basic language does not provide the necessary routines, storage, etc. which are required to perform numerical analysis to approximate the functions.

- A. Magnetic devices
- B. Rotating devices
- C. Electronic tubes

#### 4. COMPUTER OPERATION

Instructions for the GE/645/TSS terminal operation are presented in the "RADC TSS-645 Basic Reference Manual," October 1968.

#### 5. PROGRAM AVAILABILITY

The intent is to make the programs available to the users of the RADC GE/TSS/System through the system library. These users will be notified when the programs are placed in the system. Others may obtain paper tapes of the programs on request of RADC/EMNRR/GAFB/NY/13440.

#### 6. FUTURE STUDIES

It is planned by EMNRR to expand the library to include equipment and system failure rate prediction programs, and convert this library from basic to FORTRAN IV. With the advent of the FORTRAN library it is hoped that the part categories not included herein can be incorporated.

#### 7. WARNING

The computer programs herein do not have checks for values of part parameters and stress conditions which fall outside the part specifications or failure rate prediction model design.

## SECTION II

### PROGRAM LISTINGS

This section presents a computer listing of the computerized version of the "RADC Reliability Notebook," Volume II, September 1967.

These programs have been developed for piece-part failure rate predictions, i.e. they enable the reliability engineer to obtain the failure rate of a piece part for one or more stress conditions in one computer run (see Section III for examples). These programs have not been developed for obtaining failure rate predictions of equipments or systems. As discussed in Section I the development of such a library of computer programs is planned by EMNRR.

### RESISTORS

- A. Carbon composition
- B. Film
- C. Wirewound.

# CARBON COMPOSITION RESISTORS

```

00010 DIMA(10),B(10),C(10),D(10),E(10),F(10),G(150),H(60),J(60),W(4,7),L
00020 DIM VS(10),US(10)
00030 PRINTTAB(12);"FAILURE RATES FOR CARBON COMPOSITION RESISTORS"
00040 PRINT
00050 PRINT " DO YOU WISH INSTRUCTIONS --- YES OR NO?"
00060 INPUT U1
00070 IF U1="NO" GOTO0490
00080 PRINT
00090 PRINT "THIS PROGRAM CALCULATES THE BASE FAILURE RATE AND THE "
00100 PRINT "CATASTROPHIC FAILURE RATE FOR THE FIRST PERIOD OF LONGEVITY
00110 PRINT"A MULTIPLE OF THE FIRST PERIOD OF LONGEVITY FOR CARBON COMPE
00120 PRINT "IN ACCORDANCE ";
00130 PRINT"WITH THE RADG RELIABILITY NOTEBOOK, SEPT. 1967.
00140 PRINT
00150 PRINT TAB(15);"INPUT REQUIREMENTS"
00160 PRINT
00170 PRINT "1. RESISTOR STYLE"
00180 PRINT
00190 PRINT
00200 PRINT "2. RESISTANCE VALUE (OHMS)"
00210 PRINT
00220 PRINT "3. ENVIRONMENT -- LABORATORY, GROUND, ETC.."
00230 PRINT
00240 PRINT"4. THE MULTIPLE OF LONGEVITY AND THE VALUE OF P(L) IF THE"
00250 PRINT" FAILURE RATE FOR A MULTIPLE OF LONGEVITY IS TO BE CALCUL
00260 PRINT
00270 PRINT "5. STRESS CONDITIONS"
00280 PRINT
00290 PRINT " A. STRESS RATIO = OPERATING POWER/POWER RATING"
00300 PRINT " MAX, MIN AND INCREMENT"
00310 PRINT
00320 PRINT " B. OPERATING TEMPERATURE (DEGREES C)"
00330 PRINT " MAX, MIN, AND INCREMENT"
00340 PRINT
00350 PRINT "NOTES:"
00355 PRINT
00360 PRINT "THE ONLY INPUT TO THE PROGRAM THAT IS REQUIRED FROM THE"
00370 PRINT "NOTEBOOK IS THE VALUE OF THE P(L) FOR LONGEVITY"
00380 PRINT "THE REST OF THE ABOVE INPUTS ARE CODED IN THE PROGRAM"
00390 PRINT
00400 PRINT "IF ONLY ONE VALUE IS TO BE ENTERED FOR A STRESS CONDITION"
00410 PRINT "INPUT THE VALUE FOR MAX, MIN, AND INC --- EXAMPLE:1,1,1"
00420 PRINT
00430 PRINT"MAN Y OUTPUTS ARE CODED IN ACCORDANCE WITH THE INPUT CODES"
00440 PRINT
00450 PRINT "THE INPUTS ARE ENTERED BY THE KEYBOARD AS THEY ARE QUERIED"
00460 PRINT
00470 PRINT "DO YOU WISH TO RUN -- YES OR NO?"
00480 INPUT U2
00490 IF U2="YES" GOTO0490
00500 GOTO0380
00510 PRINT
00520 PRINT
00530 LET VS(8)="NO"

```

# CARBON COMPOSITION RESISTORS

```

00510 PRINT
00520 PRINT "FOR WHAT ENVIRONMENT IS THIS ANALYSIS TO BE PERFORMED?"
00530 PRINT "(1) LABORATORY (2) SATELLITE ORBIT (3) GROUND, FIXED"
00540 PRINT "(4) GROUND, PORTABLE (5) AIRBORNE, INHABITED (6) GROUND"
00550 PRINT "(7) AIRBORNE, UNINHABITED (8) SATELLITE, LAUNCH"
00560 PRINT "(9) MISSILE ----- INPUT 1,2,3,.....,OR 9";
00570 INPUT Y
00580 LET Y8=Y
00581 PRINT
00582 PRINT"GRADE OF RELIABILITY = (1) UPPER OR (2) LOWER - INPUT 1 OR 2
00583 INPUT C7
00590 PRINT
00600 PRINT "WHAT IS THE RESISTOR STYLE: (1) RC-22, (2) RC-07, (3) RC-05
00610 PRINT "(4) RC-20, (5) RC-32, (6) RC-42 OR (7) RC-08";
00620 PRINT " INPUT 1, 2, .... OR 7"
00630 INPUT S
00640 LETS1=S
00650 LET US(1)="RC-22"
00660 LET US(2)="RC-07"
00670 LET US(3)="RC-05"
00680 LET US(4)="RC-20"
00690 LET US(5)="RC-32"
00700 LET US(6)="RC-42"
00710 LET US(7)="RC-08"
00720 LET US=US(S)
00730 IF S<=3GOTO0780
00740 IF S=7GOTO0770
00750 LET S=3
00760 GOTO 0780
00770 LET S=4
00780 PRINT
00790 FOR I=1 TO 4
00800 READ A(I),B(I),D(I),E(I),F(I)
00810 NEXT I
00820 FOR I=1TO5
00830 READ G(I)
00840 NEXT I
00850 PRINT "RESISTANCE (OHMS)";
00860 INPUT G
00870 LET Y=Y8
00880 PRINT
00890 PRINT "IS THE FAILURE RATE FOR A MULTIPLE OF LONGEVITY TO BE";
00900 PRINT "CALCULATED --- YES OR NO";
00910 INPUT VS
00920 IFVS="NO"GOTO0980
00930 PRINT
00940 PRINT "MULTIPLE OF LONGEVITY AND PI(L) =";
00960 INPUTC8,C9
00970 PRINT
00980 LET R=G
00990 LET Y=Y*2
01000 IF G>99GOTO1030
01010 LET Y1=1
01020 GO TO 1130

```

# CARBON COMPOSITION RESISTORS

```

01030 IF G>1E5 GO TO 1060
01040 LET Y1=2
01050 GOTO 1130
01060 IF G>1E6 GO TO 1090
01070 LET Y1=3
01080 GO TO 1130
01090 IF G>1E7 GO TO 1120
01100 LET Y1=4
01110 GO TO 1130
01120 LET Y1=5
01130 FOR I=1 TO 18
01140 IF S>2GOTO 1170
01150 READ H(I),J(I),T,T
01160 GOTO 1210
01170 IFS>3GOTO 1200
01180 READH(I),T,J(I),T
01190 GOTO 1210
01200 READ H(I),T,T,J(I)
01210 NEXT I
01220 IFUS(8)="YES"THEN 1330
01230 PRINT
01240 PRINT "MAX, MIN AND INCREMENT OF STRESS RATIO ="
01270 INPUT B1,B2,B3
01280 PRINT
01290 PRINT "MAX, MIN AND INCREMENT OF OPER. TEMPERATURE (DEGREES C) ="
01320 INPUT T1,T2,T3
01330 FORI=1 TO5
01340 PRINT
01350 NEXTI
01360 PRINT"*****"
01370 PRINT
01380 PRINT
01390 PRINT TAB(11);"CARBON COMPOSITION RESISTORS"
01400 PRINT
01410 PRINT TAB(20);"STYLE",US
01420 PRINT
01430 PRINT TAB(10);"RESISTANCE ="J R.
01440 IF Y5<>2GOTO 1470
01450 PRINT "POWER CODE ="JY6
01460 PRINT
01470 PRINT TAB(17);"ENVIRONMENT CODE ="JY8
01480 PRINT
01481 LET V3(1)="UPPER"
01482 LET V3(2)="LOWER"
01485 PRINT TAB(13);"GRADE OF RELIABILITY ="J V3(C7)
01490 PRINT
01500 IF C9=0GOTO 1530
01510 PRINT TAB(5);"MULTIPLE OF LONGEVITY ="J C8. "PI(L) ="J C9
01520 PRINT
01530 FOR I=B2 TO B1 STEP B3
01540 PRINT
01550 PRINT "STRESS RATIO ="J I
01560 PRINT
01570 PRINT "TEMPERATURE", " FAILURE RATE (X/1000 HRS.)"

```

# CARBON COMPOSITION RESISTORS

```

01620 PRINTTAB(15);"L(B)";TAB(30);"L(R)";TAB(50);"L(RL)"
01630 PRINT
01631 IF C7=2 THEN G1635
01632 LET H=H(Y-1)
01633 LET J=J(Y-1)
01634 GOTO01640
01635 LET H=H(Y)
01636 LET J=J(Y)
01640 PRINT
01650 FOR T=T2TOT1 STEP T3
01660 LET K=F(S)*EXP(((T+273)/A(S))+D(S))*EXP((I/B(S))+E(S))
01670 LET A=(K*G(Y1)*H+J)*C9
01690 IF C9<>0GOTO1720
01700 PRINT T,K,K*G(Y1)*H+J,"NA"
01710 GOTO1750
01720 PRINT T,L,K*G(Y1)*H+J,A
01750 NEXT T
01760 PRINT
01770 NEXT I
01780 FOR I=1TO3
01790 PRINT
01800 NEXT I
01810 PRINT
01820 PRINT
01830 LET T8=0
01840 PRINT TAB(13);"MATH MODEL"
01850 PRINT
01860 PRINT" L(R)=A*EXP(((T+273)/NT)+G*EXP(((P/PO)/NS)+H");
01870 PRINT "*PI(R)*PI(E)+SIGMA(E)"
01880 PRINT
01890 PRINT " WHERE:"
01900 PRINT "A=";F(S),"NT=";A(S),"NS=";B(S)
01910 PRINT
01920 PRINT "J=";C(S),"G=";D(S),"H=";E(S),"PI(R)=";G(Y1)
01930 PRINT
01940 PRINT "UPPER PI(E)=";H(Y-1),"UPPER SIGMA(E)=";J(Y-1)
01950 PRINT
01960 PRINT "LOWER PI(E)=";H(Y),"LOWER SIGMA(E)=";J(Y)
01990 PRINT
02000 PRINT
02010 PRINT"*****"
02020 PRINT
02030 FOR I=1TO10
02040 PRINT
02050 NEXT I
02060 RESTORE
02070 PRINT "DO YOU WISH TO RUN ANOTHER ANALYSIS -- YES OR NO";
02080 INPUT US
02090 IF US="NO"THEN2380
02100 LET C9=0
02110 PRINT
02120 PRINT "IS THE ANALYSIS FOR THE SAME ENVIRONMENT -- YES OR NO";
02130 INPUT US
02140 IF US="NO"GOTO0500

```

# CARBON COMPOSITION RESISTORS

```
02150 PRINT
02160 PRINT"IS THE ANALYSIS FOR THE SAME STRESS CONDITIONS -- YES OR NO?"
02170 INPUT US(8)
02180 PRINT
02190 PRINT"IS THE ANALYSIS FOR THE SAME RESISTOR STYLE --YES OR NO?"
02200 INPUT US
02210 PRINT
02220 IF US="NO"GOTO0590
02230 PRINT
02240 LET S=S1
02250 GOTO0650
02260 DATA 25,.25,1,1,195E-13,25,.31,1,1,399E-13
02270 DATA 25,.42,1,1,1.2E-10,25,.625,1,1,3.6E-10
02280 DATA 1,1,1,1,1,1.6,2.5
02290 DATA 1,.0001,.0002,.0005, 1.5,.001,.002,.001
02300 DATA 1.04,.0001,.0002,.0005, 1.5,.001,.002,.001
02310 DATA 2,.0004,.0005,.001, 4,.002,.003,.003
02320 DATA 5,.0008,.001,.002, 10,.004,.005,.006
02330 DATA 4,.0006,.001,.001, 8,.003,.005,.003
02340 DATA 7,.001,.002,.002, 14,.005,.008,.006
02350 DATA 8,.001,.002,.002,20,.005,.008,.006
02360 DATA 15,.005,.002,.002, 40,.01,.008,.006
02370 DATA 20,.005,.003,2.003, 80,.01,.01,.01
02380 END
```



# FILM RESISTORS

```

00010 DIMA(10),B(10),C(10),D(10),E(10),F(10),G(150),H(60),J(60),W(4,7)
00020 DIM VS(10),Z(4),US(10)
00030 PRINTTAB(15);"FAILURE RATE FOR FILM RESISTORS"
00040 PRINT
00050 PRINT" DO YOU WISH INSTRUCTIONS --- YES OR NO?"
00060 INPUT US
00070 IF US="NO" GOTO0380
00080 PRINT
00090 PRINT"THIS PROGRAM CALCULATES THE BASE FAILURE RATE AND THE "
00100 PRINT"CATASTROPHIC FAILURE RATE FOR THE FIRST PERIOD OF LONGEVITY"
00110 PRINT"A MULTIPLE OF THE FIRST PERIOD OF LONGEVITY FOR FILM RESISTORS"
00120 PRINT"IN ACCORDANCE "
00130 PRINT"WITH THE RADC RELIABILITY NOTEBOOK, SEPT. 1967."
00140 PRINT
00150 PRINTTAB(15);"INPUT REQUIREMENTS"
00160 PRINT
00170 PRINT"1. RESISTOR TYPE -- POWER, PRECISION, ESTABLISHED RELIABILITY
00180 PRINT" OR INSULATED"
00190 PRINT"2. RESISTANCE VALUE
00200 PRINT"3. ENVIRONMENT -- LABORATORY, GROUND, ETC.
00210 PRINT"4. MULTIPLE OF LONGEVITY AND P(L)
00220 PRINT"5. RELIABILITY LEVEL
00230 PRINT"6. RESISTOR CHARACTERISTIC
00240 PRINT"7. RESISTOR POWER (WATTS)
00250 PRINT"8. MAX, MIN AND INC OF THE STRESS RATIO AND OPER. TEMPERATURE
00260 PRINT"9. STRESS RATIO = OPERATING POWER/RATED POWER"
00270 PRINT"NOTES"
00280 PRINT"THE ONLY INPUT TO THE PROGRAM THAT IS REQUIRED FROM THE"
00290 PRINT"NOTEBOOK IS THE VALUE OF THE P(L) FOR LONGEVITY"
00300 PRINT"THE REST OF THE ABOVE INPUTS ARE CODED IN THE PROGRAM"
00310 PRINT
00320 PRINT"MANY OF THE OUTPUTS ARE CODED IN ACCORDANCE WITH THE INPUTS"
00330 PRINT
00340 PRINT"IF ONLY ONE ENTRY IS REQUIRED FOR THE STRESS RATIO OR THE"
00350 PRINT"OPER TEMPERATURE INPUT THE SAME VALUE FOR MAX, MIN AND INC"
00360 PRINT
00370 PRINT"DO YOU WISH TO RUN -- YES OR NO?"
00380 INPUT US
00390 IF US="YES" GOTO0380
00400 GO TO 3160
00410 PRINT
00420 PRINT
00430 PRINT
00440 PRINT"FOR WHAT ENVIRONMENT IS THIS ANALYSIS TO BE PERFORMED?"
00450 PRINT"(1) LABORATORY (2) SATELLITE ORBIT (3) GROUND, FIXED"
00460 PRINT"(4) GROUND, PORTABLE (5) AIRBORNE, INHABITED (6) GROUND, UNINHABITED"
00470 PRINT"(7) AIRBORNE, UNINHABITED (8) SATELLITE, LAUNCH"
00480 PRINT"(9) MISSILE ----- INPUT 1,2,3,.....OR 9"
00490 INPUT Y
00500 LET Y8=Y
00510 LET US(8)="NO"
00520 PRINT
00530 PRINT

```

# FILM RESISTORS

```

00490 PRINT"IS THE ANALYSIS FOR (1) POWER, (2) PRECISION, (3) ESTABLISHED
00500 PRINT"RELIABILITY OR (4) INSULATED FILM RESISTORS - INPUT 1,2,3 OR
00501 INPUT Y5
00502 PRINT
00503 PRINT"GRADE OF RELIABILITY (1) UPPER OR (2) LOWER - INPUT 1 OR 2"
00504 INPUT C7
00514 IF Y5<>3 THEN 00520
00515 IF C7<>2 GO TO 00520
00516 PRINT
00517 PRINT"THE REL MAT MODEL OF THIS RESISTOR IS FOR UPPER GRADE ONLY"
00518 PRINT"SEE PAGE 45 OF THE NOTEBOOK"
00519 LET C7=1
00520 PRINT
00530 PRINT"RESISTANCE (OHMS)="
00540 INPUT R
00550 PRINT
00560 PRINT"IS THE F.R. FOR A MULTIPLE OF LONGEVITY TO BE CALCULATED ->
00570 INPUT V5(9)
00580 LET Y=Y5
00590 IF V5(9)<>"YES" GO TO 00640
00600 PRINT
00610 PRINT"MULTIPLE OF LONGEVITY AND PI(L)="
00630 INPUT C8,C9
00640 PRINT
00650 LET V5(1)="POWER FILM (MIL-R-11504)"
00660 LET V5(2)="PRECISION FILM (MIL-R-10509 (RN) )"
00670 LET V5(3)="FIXED ESTABLISHED RELIABILITY FILM (MIL-R-55182 (RNR) )"
00680 LET V5(4)="INSULATED FIXED FILM (MIL-R-22684 (RL) )"
00690 LET V5=V5(Y5)
00700 IF Y5 <> 3 GO TO 0760
00710 PRINT"RELIABILITY LEVEL ="
00720 PRINT" ( (1) S, (2) R, (3) P OR (4) M ) -- INPUT 1,2,3 OR 4"
00730 INPUT Y7
00740 LET S=6
00750 PRINT
00760 IF Y5<>4 GO TO 00780
00770 LET S=7
00780 ON Y5 GO TO 00790,00770,1000,1000
00790 PRINT"RESISTOR CHARACTERISTIC = P OR G"
00800 INPUT U5
00810 PRINT
00820 IF U5="P" GO TO 00850
00830 LET S=2
00840 GO TO 1000
00850 LET S=1
00860 GO TO 1000
00870 REM PRECISION FILM
00880 PRINT"WHAT IS THE RESISTOR CHARACTERISTIC (1) B,D (2) C,E,F"
00890 PRINT"OR (3) G ---- INPUT 1,2, OR 3"
00900 LET U5(1)="B,D"
00910 LET U5(2)="C,E, AND F"
00920 LET U5(3)="G"
00930 INPUT S
00940 LET U5=U5(S)

```

# FILM RESISTORS

```

00950 PRINT
00960 PRINT"WHAT IS THE RES. POWER (1) 1/20, (2) 1/16, (3) 1/8, (4) 1/4
00970 PRINT"(5) 1/2, (6) 3/4, (7) 1, OR (8) 2 WATTS"
00980 PRINT"INPUT 1,2,3,.....OR 8"
00990 INPUT Y6
00995 LET C6=Y6
01000 IF S=2THEN01020
01010 LET Y6=Y6-1
01020 FOR I=1 TO 7
01030 READ A(I),B(I),C(I),D(I),E(I),F(I)
01040 NEXT I
01050 FOR I=1TO94
01060 READ G(I)
01070 NEXT I
01080 PRINT
01090 IF US(8)="YES"GOTO1230
01100 PRINTTAB(17);"STRESS CONDITIONS"
01110 PRINT
01120 PRINT"MAX, MIN AND INC OF STRESS: RATIO"
01160 INPUT B1,B2,B3
01170 PRINT
01180 PRINT"MAX, MIN AND INC OF OPER TEMPERATURE (DEGREES C)"
01210 INPUT T1,T2,T3
01220 PRINT
01230 ONY5GOTO1300,1240,1300,1330
01240 LETI=S*25+4
01250 FOR I1=1TO4
01260 FOR I2=7TO1STEP-1
01270 LET W(I1,I2)=G(I)
01280 LET I=I-1
01290 NEXT I2
01300 NEXT I1
01310 LET S=S+2
01320 LET Y=Y+2+9
01330 PRINT
01340 PRINT
01350 IF Y5>2 GO TO 1470
01360 IF R>99 GO TO 1390
01370 LET Y1=1
01380 GO TO1630
01390 IF R=100000 GO TO1420
01400 LET Y1=2
01410 GO TO1630
01420 IF R=1E6 GO TO1450
01430 LET Y1=3
01440 GO TO1630
01450 LET Y1=4
01460 GO TO1630
01470 IF R>99 GO TO 1500
01480 LET Y1=1
01490 GO TO 1570
01500 IF R=1E4 GO TO1530
01510 LET Y1=2
01520 GO TO1570

```

# FILM RESISTORS

```

01530 IF R>1E5 GO TO 1560
01540 LET Y1 =3
01550 GOTO 1570
01560 LET Y1=4
01570 LET Y1=Y1+88
01580 LET Y=Y+27
01590 IF Y5=3GOTO1630
01600 LET Y1=Y1+4
01610 LET Y=Y-27
01620 LET Y=Y+2+36
01630 FOR I=1TO54
01640 READ H(I),J(I)
01650 NEXT I
01660 FOR I=1TO 4
01670 READ Z(I)
01680 NEXT I
01690 IF Y5<>2GOTO1710
01700 LET G(Y1)=W(Y1,Y6)
01710 PRINT
01720 PRINTTAB(17);V5
01730 PRINT
01740 IF Y5>2 GO TO1760
01750 PRINTTAB(17);"CHARACTERISTIC ";US
01760 PRINT
01770 PRINTTAB(10);"RESISTANCE =";R,
01780 IF Y5<>2GOTO1810
01790 PRINT"POWER CODE =";C6
01800 PRINT
01810 PRINTTAB(17);"ENVIRONMENT CODE =";Y8
01820 PRINT
01821 LET VS(1)="UPPER"
01822 LETVS(2)="LOWER"
01823 PRINTTAB(13);"GRADE OF RELIABILITY =";VS(C7)
01824 PRINT
01830 IF Y5<>3GOTO1870
01840 PRINTTAB(10);"RELIABILITY LEVEL CODE =";
01850 PRINTY7
01860 PRINT
01870 IF C9=8GOTO1900
01880 PRINTTAB(5);"MULTIPLE OF LONGEVITY =";C8, "PI(L)=";C9
01890 PRINT
01900 FOR I=B2TOB1 STEP B3
01910 PRINT
01920 PRINT"STRESS RATIO =";I
01930 PRINT
01940 PRINT"TEMPERATURE", " FAILURE RATE (1/1000 HRS.)"
01950 PRINTTAB(15);"L(B)";TAB(30);"L(R)";TAB(50);"L(RL)"
01965 IF G(Y1)<>0THEN02000
01966 PRINT
01967 PRINT"THE RESISTANCE FACTOR, PI(RW), FOR THIS RESISTANCE AND WATTE
01968 PRINT"IS NA -- SEE THE NOTEBOOK PAGE 41"
01969 GOTO022740
02000 PRINT
02001 IF C7=200 TO02006

```

# FILM RESISTORS

```

02002 LET H=H(Y-1)
02003 LET J=J(Y-1)
02004 GOTO 02010
02006 LET H=H(Y)
02007 LET J=J(Y)
02010 ONLY 50 TO 2020, 2250, 2250, 2020
02020 FOR T=T2 TO T1 STEP 3
02030 LET K=F(S)*EXP(((T+273)/A(S))*D(S))
02040 LET K=K*EXP(((1/B(S))*((T+273)/273)*C(S))*E(S))
02050 LET A=(K*G(Y1)*H+J)*C9
02070 IF Y5=1 GO TO 2150
02080 IF C9<>0 GO TO 2110
02090 PRINTT,K,K*G(Y1)*H+J,"NA"
02100 GO TO 2140
02110 PRINTT,K,K*G(Y1)*H+J,A
02140 GO TO 2210
02150 IF C9<>0 THEN 02190
02160 PRINTT,K,(K*G(Y1)*H+J)/2.5,"NA"
02170 GO TO 2210
02190 PRINTT,K,(K*G(Y1)*H+J)/2.5,A/2.5
02210 NEXT T
02220 NEXT I
02230 GO TO 02270
02240 PRINT
02250 FOR T=T2 TO T1 STEP 3
02260 LET K=F(S)*EXP(((T+273)/A(S))*D(S))*EXP((1/B(S))*E(S))
02270 LET A=(K*G(Y1)*H+J)*C9
02290 IF Y5<>3 GO TO 2370
02300 IF C9<>0 THEN 02340
02310 PRINTT,K,K*G(Y1)*Z(Y7)*H,"NA"
02320 GOTO 02360
02340 PRINTT,K,K*G(Y1)*Z(Y7)*H,K*G(Y1)*Z(Y7)*H*C9
02360 GO TO 2430
02370 IF C9<>0 THEN 02410
02380 PRINTT,K,K*G(Y1)*H+J,"NA"
02390 GO TO 2430
02410 PRINTT,K,K*G(Y1)*H+J,A
02430 NEXT T
02440 LET T5=1
02450 GOTO 02220
02460 FOR I=1 TO 3
02470 PRINT
02480 NEXT I
02730 PRINT
02740 FOR I=1 TO 10
02750 PRINT
02760 NEXT I
02770 RESTORE
02780 PRINT"DO YOU WISH TO RUN ANOTHER ANALYSIS -- YES OR NO?"
02790 INPUT U$
02800 IF U$="NO" GO TO 3100
02810 LET C9=0
02820 PRINT
02830 PRINT"IS THE ANALYSIS FOR THE SAME ENVIRONMENT -- YES OR NO?"

```

# FILM RESISTORS

```

02840 INPUT US
02850 IF US="NO" GO TO 0390
02860 PRINT
02870 PRINT "IS THE ANALYSIS FOR THE SAME STRESS CONDITIONS -- YES OR NO?"
02880 INPUT US(8)
02890 PRINT "IS THE ANALYSIS FOR THE SAME RESISTOR TYPE -- YES OR NO?"
02900 INPUT US
02910 IF US="NO" GO TO 0450
02920 GO TO 0320
02930 DATA 551, 1.45, .89, 2.6, 1.3, 1.1E-3
02940 DATA 551, .72, .89, 2.6, 1.3, 1.1E-3
02950 DATA 90, 1.09, 0.1, 1.1, 1.87E-6, 108, 1.05, 0.1, 1.2, 5E-5
02960 DATA 90, 1.09, 0.1, 1.1, 1.93E-6
02970 DATA 108, 1.05, 0.1, 1.2, 5E-6, 320, 2.1, 1.1, 1.94, 3.26, 1, 305E-6
02980 DATA 1.2, 1, 1.3, 3.5
02990 DATA 0, 0, 0, 3, 4.5, 3.6, 4.2, 0, 3.75, 2.5, 2.5, 3.75, 3, 3.5
03000 DATA 2, 1.5, 1, 1, 1.5, 1.2, 1.4, 3, 2.25, 1.5, 1.5, 2.25, 1.8, 2.1
03010 DATA 0, 0, 0, 0, 0, 4.5, 3.6, 0, 0, 3.75, 2.5, 2.5, 3.75, 3
03020 DATA 3, 2, 1.5, 1, 1, 1.5, 1.2, 4.5, 3, 2.25, 1.5, 1.5, 2.25, 1.8
03030 DATA 0, 0, 3, 3, 4.5, 3.6, 4.2, 5, 3.75, 2.5, 2.5, 3.75, 3, 3.5
03040 DATA 2, 1.5, 1, 1, 1.5, 1.2, 1.4, 3, 2.25, 1.5, 1.5, 2.25, 1.8, 2.1
03050 DATA 1.4, 1, 1.2, 5, 1.5, 1.2, 2.4
03060 DATA 1, .001, 1.5, .0015, 5, .01, 7.5, .015, 6.5, .018, 12, .03, 15, .04
03070 DATA 25, .08, 35, .1
03080 DATA 1.5E-5, 3, .0002, 1.01, .00005, 3, 2E-4, 2.5, 1E-4, 8, 4E-4
03090 DATA 6, 2E-4, 20, 1E-3, 5, 2E-4, 15, 1E-3, 10, 5E-4, 20, 2E-3, 12, 6E-4
03100 DATA 50, 25E-5, 18, 1E-3, 75, 4E-3, 25, 2E-3, 100, 1E-2
03110 DATA 1, 0, 1, 0, 1, 0, 2.5, 0, 6, 0, 5, 0, 10, 0, 12, 0, 18, 0, 25, 0
03120 DATA .2, 0, 1, 0, .3, 0, .0001, 1.5, .0001, 1, .0005, 5, .001, 1.5, .0005
03130 DATA 7.5, .0015, 1.4, .0008, 6.5, .0013, 2.5, .001, 12, .002, 3, .0012
03140 DATA 15, .0025, 10, .002, 25, .004, 15, .003, 35, .006
03150 DATA .1, 3E-1, 1.0, 6
03160 END
03170 PRINT

```

# FIXED WIREWOUND RESISTORS

```

00010 DIMA(10),B(10),C(10),D(10),E(10),F(10),G(150),H(60),J(60),W(4,7),
00020 DIMVS(10),US(10),LS(50)
00030 PRINT TAB(13);"FAILURE RATE FOR FIXED WIREWOUND RESISTORS"
00040 PRINT
00050 PRINT " DO YOU WISH INSTRUCTIONS --- YES OR NO?"
00060 INPUT US
00070 IFUS="NO"THEN0430
00080 PRINT
00090 PRINT "THIS PROGRAM CALCULATES THE BASE FAILURE RATE AND THE "
00100 PRINT "CATASTROPHIC FAILURE RATE FOR THE FIRST PERIOD OF LONGEVITY
00110 PRINT "A MULTIPLE OF THE FIRST PERIOD OF LONGEVITY OF WIREWOUND RE
00120 PRINT "IN ACCORDANCE ";
00130 PRINT "WITH THE RADC RELIABILITY NOTEBOOK, SEPT. 1967.
00140 PRINT
00150 PRINT TAB(15);"INPUT REQUIREMENTS"
00160 PRINT
00170 PRINT"1. RESISTOR TYPE -- ACCURATE OR POWER
00180 PRINT " OR INSULATED"
00190 PRINT "2. RESISTANCE VALUE
00200 PRINT "3. ENVIRONMENT -- LABORATORY, GROUND, ETC.
00210 PRINT"4. VALUE OF PI(L) FOR MULTIPLE OF LONGEVITY
00220 PRINT"5. RELIABILITY GRADE -- UPPER OR LOWER
00230 PRINT "6. RESISTOR CHARACTERISTIC
00240 PRINT"7. MAX, MIN AND INCREMENT OF THE STRESS RATIO AND OPER TEM
00250 PRINT TAB(13);"STRESS RATIO = OPERATING POWER/RATED POWER"
00260 PRINT
00270 PRINT "NOTES"
00280 PRINT "THE ONLY INPUT TO THE PROGRAM THAT IS REQUIRED FROM THE"
00290 PRINT "NOTEBOOK IS THE VALUE OF THE PI(L) FOR LONGEVITY"
00300 PRINT "AND THE RESISTANCE STYLE -- EXAMPLE RW 70"
00310 PRINT
00320 PRINT "THE REST OF THE ABOVE INPUTS ARE CODED IN THE PROGRAM"
00330 PRINT
00340 PRINT "MANY OF THE OUTPUTS ARE CODED IN ACCORDANCE WITH THE INPUT
00350 PRINT
00360 PRINT "IF ONLY ONE ENTRY IS REQUIRED FOR THE STRESS RATIO OR THE"
00370 PRINT "OPER TEMPERATURE INPUT THE SAME VALUE FOR MAX, MIN AND INC
00380 PRINT
00390 PRINT "DO YOU WISH TO RUN -- YES OR NO?"
00400 INPUT US
00410 IFUS="YES"THEN0430
00420 GOTO0870
00430 PRINT
00440 PRINT
00450 PRINT
00460 PRINT "FOR WHAT ENVIRONMENT IS THIS ANALYSIS TO BE PERFORMED?"
00470 PRINT "(1) LABORATORY (2) SATELLITE ORBIT (3) GROUND, FIXED"
00480 PRINT "(4) GROUND, PORTABLE (5) AIRBORNE, INHABITED (6) GROUND
00490 PRINT "(7) AIRBORNE, UNINHABITED (8) SATELLITE, LAUNCH"
00500 PRINT "(9) MISSILE ----- INPUT 1,2,3,.....OR 9"
00510 INPUTY
00520 LET Y8=Y
00530 LETUS=""
00540 LET US(8)="NO"

```

# FIXED WIREWOUND RESISTORS

```

00550 PRINT
00560 PRINT
00570 PRINT "IS THE ANALYSIS FOR (1) ACCURATE OR (2) POWER WIREWOUND"
00580 PRINT "RESISTORS -- INPUT 1 OR 2"
00590 INPUT Y5
00600 PRINT
00610 LET US(1)="ACCURATE WIREWOUND FIXED RESISTOR (MIL-R-93 (RB))"
00620 LET US(2)="POWER WIREWOUND FIXED RESISTOR (MIL-R-26 (RW))"
00630 IF US(7)="YES" THEN 0670
00640 PRINT "GRADE OF RELIABILITY (1) UPPER OR (2) LOWER -- INPUT 1 OR 2"
00650 INPUT C7
00660 REM
00670 PRINT
00680 LET Y=Y8
00690 PRINT "RESISTANCE (OHMS)="
00700 INPUT R
00710 PRINT
00720 PRINT "IS THE F.R. FOR A MULTIPLE OF LONGEVITY TO BE CALCULATED"
00730 INPUT VS(9)
00740 LET Y=Y8
00750 IF VS(9) <> "YES" THEN 0790
00760 PRINT
00770 PRINT "MULTIPLE OF LONGEVITY AND PI(L)="
00780 INPUT C8, C9
00790 PRINT
00800 IF US(8)="YES" THEN 0890
00810 PRINT TAB(13); "STRESS CONDITIONS"
00820 PRINT
00830 PRINT "MAX. MIN AND INCREMENT OF STRESS RATIO ="
00840 INPUT D1, D2, D3
00850 PRINT
00860 PRINT "MAX. MIN AND INCREMENT OF OPERATING TEMPERATURE (DEGREES C)"
00870 INPUT T1, T2, T3
00880 PRINT
00890 FOR I=1 TO 3
00900 READ A(I), B(I), C(I), D(I), E(I), F(I)
00910 NEXT I
00920 FOR I=1 TO 7
00930 READ G(I)
00940 NEXT I
00950 FOR I=1 TO 36
00960 READ H(I), J(I)
00970 NEXT I
00980 LET Y=2*Y
00990 IF Y=8 THEN 1200
01000 LET S=1
01010 IF R>.1 THEN 1040
01020 LET Y1=1
01030 GOTO 1760
01040 IF R>1 THEN 1070
01050 LET Y1=2
01060 GOTO 1760
01070 IF R>10 GOTO 1100
01080 LET Y1=3

```



# FIXED WIREWOUND RESISTORS

```

01090 GOTO 1760
01100 IFR>1E4 THEN 1130
01110 LET Y1=4
01120 GOTO 1760
01130 IFR>1E5 THEN 1160
01140 LET Y1=5
01150 GOTO 1760
01160 IFR>1E6 THEN 1200
01170 LET Y1=6
01180 GOTO 1760
01190 LET Y1=7
01200 LET Y=Y+10
01210 PRINT
01220 PRINT "RESISTANCE CHARACTERISTIC = U OR V"
01230 INPUT U
01240 IF U$="V" THEN 1270
01250 LET S=2
01260 GOTO 1280
01270 LET S=3
01280 FOR I=1 TO 35
01290 READ L$(I)
01300 NEXT I
01310 PRINT
01320 PRINT "RESISTOR STYLE = (SEE NOTEBOOK PAGE 63)"
01330 PRINT
01340 INPUT V$
01350 PRINT
01360 FOR I=1 TO 35
01370 IF V$=L$(I) THEN 1430
01380 NEXT I
01390 PRINT "THE STYLE ENTRY IS NOT AS IN THE NOTEBOOK TRY AGAIN"
01400 RESTORE 3
01410 PRINT
01420 GOTO 1320
01430 FOR J1=1 TO ((I-1)*5)
01440 READ A$
01450 NEXT J1
01460 FOR I=1 TO 8
01470 READ G(I)
01480 PRINT G(I),
01490 NEXT I
01500 IF R>1 THEN 1520
01510 LET Y1=1
01520 IF R>10 THEN 1550
01530 LET Y1=2
01540 GOTO 1760
01550 IF R>100 THEN 1580
01560 LET Y1=3
01570 GOTO 1760
01580 IFR>1000 THEN 1610
01590 LET Y1=4
01600 GOTO 1760
01610 IFR>1E4 GOTO 1640
01620 LET Y1=5

```

# FIXED WIREWOUND RESISTORS

```

01630 GOTO1760
01640 IFR>1E5THEN1660
01650 LETY1=6
01660 IFR>1.5E5THEN1690
01670 LET Y1=7
01680 GOTO1760
01690 IFR>2E5THEN1720
01700 LET Y1=8
01710 GOTO1760
01720 PRINT "THE VALUE IS TO GREAT FOR THIS ANALYSIS. TRY AGAIN."
01730 RESTORE
01740 RESTORES
01750 GO TO 0690
01760 FORI=1TO6
01770 PRINT
01780 NEXTI
01790 PRINTTAB(13);US(Y5)
01800 PRINT
01810 IFY5<>2THEN1840
01820 PRINT TAB(17);"CHARACTERISTIC ";US
01830 PRINT
01840 PRINT TAB(10);"RESISTANCE =" ;R
01850 PRINT TAB(17);"ENVIRONMENT CODE =" ;Y8
01860 PRINT
01870 LET VS(1)="UPPER"
01880 LETVS(2)="LOWER"
01890 PRINT TAB(13);"GRADE OF RELIABILITY =" ;VS(C7)
01900 PRINT
01910 IF C9=0THEN1940
01920 PRINT TAB(5);"MULTIPLE OF LONGEVITY =" ;C8, "PI(L) =" ;C9
01930 PRINT
01940 FOR I=B2TOB1 STEP B3
01950 PRINT
01960 PRINT "STRESS RATIO =" ;I
01970 PRINT
01980 PRINT "TEMPERATURE", " FAILURE RATE (1/1000 HRS.)"
01990 PRINTTAB(15);"L(B)";TAB(30);"L(R)";TAB(50);"L(RL)"
02000 IF(Y1)<>0THEN02050
02010 PRINT
02020 PRINT"THE RESISTANCE FACTOR, PI(RW), FOR THIS RESISTANCE AND WATTE
02030 PRINT"IS NA -- SEE THE NOTEBOOK PAGE 64"
02040 GOTO02080
02050 PRINT
02060 IF(C7)=2THEN02100
02070 LETH=H(Y-1)
02080 LETJ=J(Y-1)
02090 GOTO2100
02100 LETH=H(Y)
02110 LETJ=J(Y)
02120 ON Y800 TO2130,2250
02130 FOR T=T2TOT1STEPT3
02140 LET K=F(S)*EXP(((T+B73)/A(S))+D(S))
02150 LET K=K*EXP(((1/B(S))*((T+B73)/B73)+C(S))+E(S))
02160 LETA=(K*G(Y1)+H+J)*C9

```

# FIXED WIREWOUND RESISTORS

```

02170 IFC9<>0 THEN 2200
02180 PRINT T,K,K*G(Y1)*H+J,"NA"
02190 GOTO 2210
02200 PRINT T,K,K*G(Y1)*H+J,A
02210 NEXT T
02220 NEXT I
02230 GOTO 2350
02240 PRINT
02250 FOR T=T2 TO T1 STEP T3
02260 LET K=F(S)*EXP(((T+273)/A(S))4D(S))*EXP((1/B(S))4E(S))
02270 LET A=(K*G(Y1)*H+J)*C9
02280 IFC9<>0 THEN 2310
02290 PRINT T,K,K*G(Y1)*H+J,"NA"
02300 GOTO 2320
02310 PRINT T,K,K*G(Y1)*H+J,A
02320 NEXT T
02330 LET T8=1
02340 GOTO 2220
02350 FOR I=1 TO 3
02360 PRINT
02370 NEXT I
02380 PRINT A(S),B(S),C(S),D(S),E(S),F(S),H,J,G(Y1),C9
02390 FOR I=1 TO 10
02400 PRINT
02410 NEXT I
02420 RESTORE
02430 RESTORE$
02440 PRINT "ANOTHER ANALYSIS -- YES OR NO";
02450 INPUT US
02460 IF US<>"NO" THEN 2480
02470 GOTO 2870
02480 LET C9=0
02490 PRINT
02500 PRINT "IS THE ANALYSIS FOR THE SAME ENVIRONMENT -- YES OR NO";
02510 INPUT US
02520 IF US="NO" THEN 0430
02530 PRINT
02540 PRINT "IS THE ANALYSIS FOR THE SAME STRESS CONDITIONS -- YES OR NO";
02550 INPUT US(8)
02560 PRINT
02570 PRINT "IS THE ANALYSIS FOR THE SAME RESISTOR TYPE -- YES OR NO";
02580 INPUT US(7)
02590 IF US(7)="NO" THEN 0550
02600 GOTO 0610
02610 DATA 418.6,.94,.54,10.7,1.57,653E-6,398,.32,0.2,1.2.75E-4
02620 DATA 310,.32,0.2,1.1.83E-4,4.2,1.1,1.1.7,3.5
02630 DATA 1,0,3,0,1.5,0.4,5,0.6,.002,18,.006,12,.004,36,.012
02640 DATA 15,.005,45,.015,30,.01,90,.03,20,.007,60,.021,60,.02
02650 DATA 180,.06,70,.025,200,.075
02660 DATA 1,0,4,.002,1.2,.0006,5,.0025,3,15E-4,13,65E-4,7,35E-5
02670 DATA 35,175E-4,6,3E-3,30,.015,10,.005,60,.03,12,.006,72,.036
02680 DATA 22,.011,132,.066,30,.015,180,.090
02690 DATA RW 10,RW 11,RW 12,RW 13,RW 14,RW 15,RW 16,RW 20,RW 21,RW 22
02700 DATA RW 23,RW 24,RW 29,RW 30,RW 31,RW 32,RW 33,RW 34,RW 35,RW 36

```

# FIXED WIREWOUND RESISTORS

02710 DATARW 37,RW 38,RW 39,RW 47,RW 55,RW 56,RW 67,RW 68,RW 69,RW 70  
 02720 DATARW 74,RW 78,RW 79,RW 80,RW 81  
 02730 DATA 1.4,1,1,1,1,1,1.2,1.6,1.4,1,1,1,1,1.2,1.6,0  
 02740 DATA1.4,1,1,1,1.2,1.6,0,0,1.4,1,1,1,1.2,0,0,1.4,1,1,1,1.2,0,0  
 02750 DATA1.4,1,1,1,1.2,2,0,0,1.8,1.2,1,1.2,1.4,0,0,0,1.6,1.2,1,1,1.6,00  
 02760 DATA1.6,1,1,1,1.2,2,0,0,1.6,1,1,1,1.2,1.6,0,0,1.6,1,1,1,1.4,0,0  
 02770 DATA1.6,1,1,1,1.2,0,0,1.6,1.4,1,1,1.4,0,0,0  
 02780 DATA1.6,1.2,1,1.2,1.6,0,0,0,1.6,1.2,1,1,1.4,0,0,0,1.6,1,1,1,1.2,00  
 02790 DATA1.4,1,1,1,1.4,0,0,1.4,1,1,1,1.4,0,0,1.4,1,1,1,1.4,0,0  
 02800 DATA1.4,1.2,1,1,1.2,1.5,0,0,1.4,1.4,1,1,1.2,1.6,0,0,1.4,1.2,1,1,1.4  
 02810 DATA1.6,0, 1.4,1.4,1,1,1,1.4,1.6,2,1.4,1.4,1,1,1,1.4,1.6,2  
 02820 DATA1.6,1.2,1,1,1.4,2.4,0,0,1.6,1.2,1,1,1.2,2.60,0,0  
 02830 DATA 1.6,1.2,1,1,1,0,0,0,1.6,1.2,1,1,1,0,0,0,1.6,1.2,1,1,0,0,0,0  
 02840 DATA1.6,1.2,1,1.2,1.4,0,0,0,1.6,1.2,1,1,1.2,1.6,0,0  
 02850 DATA 1.6,1.2,1,1,1,1.6,0,0,1.6,1.2,1,1,1.4,0,0,0,1.6,1.2,1,1.2,1.6  
 02860 DATA0,0,0,2,1.6,1,1.2,0,0,0,0  
 02870 END

# POTENTIOMETERS (VARIABLE RESISTORS)

```

00010 DIMA(8),B(8),C(8),D(8),E(8),F(8),H(130),G(60),J(10),W(6,6)
00020 DIMVS(10),US(10),S(20),L(20)
00030 PRINT TAB(12);"FAILURE RATES FOR POTENTIOMETERS"
00040 PRINT
00050 PRINT " DO YOU WISH INSTRUCTIONS --- YES OR NO";
00060 INPUT US
00070 FOR I=1TO8
00080 PRINT
00090 NEXT I
00100 IFUS="NO"THEN0480
00110 PRINT "THIS PROGRAM CALCULATES THE BASE FAILURE RATE AND THE "
00120 PRINT "CATASTROPHIC FAILURE RATE FOR THE FIRST PERIOD OF LONGEVITY
00130 PRINT"A MULTIPLE OF THE FIRST PERIOD OF LONGEVITY FOR POTENTIOMETER
00140 PRINT "IN ACCORDANCE ";
00150 PRINT"WITH THE RADG RELIABILITY NOTEBOOK, SEPT. 1967.
00160 PRINT
00170 PRINT TAB(11);"INPUT REQUIREMENTS"
00180 PRINT
00190 PRINT
00200 PRINT "ENVIRONMENT - LABORATORY, SATELLITE ORBIT, ETC."
00210 PRINT
00220 PRINT"APPLIED VOLTAGE, RATED VOLTAGE, RESISTANCE (OHMS)"
00230 PRINT
00240 PRINT "NUMBER OF TAPS, NUMBER OF SECTIONS, GANG - FIRST, SECOND, E
00250 PRINT
00260 PRINT "AND THE VALUE OF P1(EFF) F IN ACCORDANCE WITH STEP 3"
00270 PRINT
00280 PRINT"PAGE 78 OF THE NOTEBOOK"
00290 PRINT
00300 PRINT "NOTES:"
00310 PRINT
00320 PRINT"THE USER IS GIVEN THE OPTION OF INPUTING OR HAVING THE"
00330 PRINT"STRESS RATIO CALCULATED BY THE COMPUTER"
00340 PRINT
00350 PRINT "THE NUMBER OF SECTIONS AND";
00360 PRINT"THE VALUE OF P1(EFF) IS NOT REQUIRED IF THE ADJUSTED STRESS"
00370 PRINT"RATIO HAS BEEN PREASSIGNED."
00380 PRINT
00390 PRINT "MANY OF THE OUTPUTS ARE CODED IN ACCORDANCE WITH THE INPUTS
00400 PRINT
00410 PRINT "IF ONLY ONE VALUE FOR A GIVEN STRESS CONDITION IS DESIRED"
00420 PRINT"INPUT THAT VALUE FOR MAX, MIN AND INCREMENT"
00430 PRINT
00440 PRINT"DO YOU WISH TO RUN -- YES OR NO"
00450 INPUT US
00460 IFUS="NO"THEN3270
00470 PRINT
00480 PRINT "ENVIRONMENT: (1) LAB, (2) SO, (3) GF, (4) GP,"
00490 PRINT
00500 PRINT "(5) AI, (6) GM, (7) AU, (8) SL, (9) MIL -- INPUT 1,2,...,9"
00510 INPUTY
00520 LET Y8=Y
00530 PRINT
00540 PRINT "ANALYSIS FOR: (1) PRECISION, (2) SEMI-PRECISION,"

```

# POTENTIOMETERS (VARIABLE RESISTORS)

```

00550 PRINT"(3) LOW-PRECISION, (4) NON-WIREWOUND, (5) WIREWOUND,"
00560 PRINT"(6) ESTABLISHED RELIABILITY OR (7) HIGH POWER"
00570 PRINT "INPUT 1,2,..., OR 7";
00580 INPUT Y5
00590 LET V5(1)="PRECISION POTENTIOMETERS"
00600 LET V5(2)="SEMI-PRECISION POTENTIOMETERS"
00610 LET V5(3)="LOW-PRECISION POTENTIOMETERS"
00620 LET V5(4)="NON-WIREWOUND POTENTIOMETERS"
00630 LET V5(5)="WIREWOUND POTENTIOMETERS"
00640 LET V5(6)="ESTABLISHED RELIABILITY POTENTIOMETERS"
00650 LET V5(7)="HIGH POWER POTENTIOMETERS"
00660 LET V5(8)=V5(Y5)
00670 PRINT
00680 PRINT "STRESS RATIO TO BE CALCULATED - YES OR NO";
00690 INPUT U5(7)
00700 PRINT
00710 PRINT "GRADE OF RELIABILITY = (1) UPPER OR (2) LOWER -- INPUT 1 OR
00720 INPUT C7
00730 PRINT
00740 PRINT"IS FAILURE RATE FOR A MULTIPLE OF LONGEVITY TO BE CALCULATED
00750 PRINT"INPUT YES OR NO"
00760 INPUT U5(5)
00770 IF U5(5)="NO" THEN 0820
00780 PRINT
00790 PRINT"MULTIPLE OF LONGEVITY AND PI(L)=";
00800 INPUT C8,C9
00810 PRINT
00820 PRINT"APPLIED VOLTAGE";
00830 INPUT N5
00840 LET N6=N5
00850 PRINT
00860 PRINT"RATED VOLTAGE";
00870 INPUT N4
00880 LET N5=N5/N4
00890 PRINT
00900 PRINT "RESISTANCE (OHMS)";
00910 INPUT R
00920 PRINT
00930 PRINT "NUMBER OF TAPS";
00940 INPUT N1
00950 PRINT
00960 IF U5(7)="NO" THEN 1090
00970 PRINT"NUMBER OF SECTIONS";
00980 INPUT N2
00990 PRINT
01000 PRINT"(1) FIRST, (2) SECOND, (3) THIRD, (4) FOURTH, (5) FIFTH"
01010 PRINT "OR (6) SIXTH IN GANG --- INPUT 1,2, ..., 6";
01020 INPUT N3
01030 PRINT
01040 PRINT "PI(EFF)=? -- SEE STEP 3, PAGE 78)";
01050 INPUT W2
01060 PRINT
01070 PRINT "RATED WATTAGE =";
01080 INPUT W1

```

# POTENTIOMETERS (VARIABLE RESISTORS)

```

01090 LETN1=N1*(3/2)/25+.792
01100 IFU5(6)="YES"THEN1180
01110 IFU5(7)="YES"THEN1140
01120 PRINT"MAX, MIN AND INCREMENT OF STRESS RATIO";
01130 INPUT B1,B2,B3
01140 PRINT
01150 PRINT"MAX, MIN AND INCREMENT OF OPER TEMPERATURE - DEG C";
01160 INPUT T1,T2,T3
01170 PRINT
01180 FORI=1TO6
01190 FORJ1=1TO6
01200 READ W(I,J1)
01210 NEXTJ1
01220 NEXTI
01230 FORI=1TO7
01240 READA(I),B(I),C(I),D(I),E(I),F(I)
01250 NEXT I
01260 FOR I=1TO126
01270 READ H(I)
01280 NEXT I
01290 LET Y=(Y5-1)*18+2*Y
01300 IFH(Y)<>0THEN1330
01310 PRINT"THIS POTENTIOMETER IS NOT DESIGNED FOR THIS ENVIRONMENT"
01320 GO TO2740
01330 FORI=1TO52
01340 READG(I)
01350 NEXT I
01360 FORI=1TO7
01370 READ S(I)
01380 NEXTI
01390 FORI=1TO7
01400 IFI=Y5THEN1460
01410 FORJ1=1TOS(I)
01420 READ A8
01430 LETA9=A9+1
01440 NEXTJ1
01450 NEXTI
01460 LETJ1=0
01470 FOR I1=1TOS(I)
01480 LETA9=A9+1
01490 READ A8
01500 IFR<=A8THEN1520
01510 NEXT I1
01520 LETG1=G(A9)
01530 IFA9=52THEN1530
01540 LET A9=A9+1
01550 FORI=A9TO52
01560 READ A8
01570 NEXTI
01580 GOSUB1600
01590 GOTO1650
01600 FOR I=1TO11
01610 READL(I)
01620 NEXTI

```

# POTENTIOMETERS (VARIABLE RESISTORS)

```

01630 LETA7=A7+1
01640 RETURN
01650 IF Y5=4 THEN 1680
01660 IF Y5=3 THEN 1680
01670 GOTO 1690
01680 GOSUB 1600
01690 LET J1=0
01700 FOR I=0 TO 1 STEP .1
01710 LET J1=J1+1
01720 IF N5<I+.1 THEN 1770
01730 GOTO 1760
01740 LET J1=J1+1
01750 GOTO 1770
01760 NEXT I
01770 IF A7<>2 THEN 1790
01780 GOTO 1820
01790 LET K1=L(J1)
01800 LET J5=1
01810 GOSUB 1600
01820 IF J5<>1 THEN 1840
01830 GOTO 1850
01840 LET K1=L(J1)
01850 LETA8=A9=A7=J1=J4=J5=0
01860 IF Y5=1 THEN 1910
01870 IF Y5=6 THEN 1970
01880 IF Y5=7 THEN 2060
01890 LET K3=1
01900 GOTO 2080
01910 PRINT "CONSTRUCTION=1,2,3,4,5,OR 6";
01920 INPUT K4
01930 FOR I=1 TO K4
01940 READ K3
01950 NEXT I
01960 GOTO 2080
01970 FOR I=1 TO 6
01980 READ K4
01990 NEXT I
02000 PRINT "FAILURE RATE CLASS=(1) S, (2) R, (3) P OR (4) M -- INPUT 1,2,3,4,5,OR 6";
02010 INPUT K4
02020 FOR I=1 TO K4
02030 READ K3
02040 NEXT I
02050 GOTO 2080
02060 PRINT "CONSTRUCTION CLASS = (1) OPEN OR (2) ENCLOSED - INPUT 1 OR 2";
02070 INPUT K3
02080 PRINT
02090 IF W(N2,N3)<>0 THEN 2130
02100 IF U$(7)="NO" THEN 2150
02110 PRINT "PI(GANGED)=NA -- SEE TABLE III-3, PAGE 80 - RADCL REL NTB."
02120 GOTO 2740
02130 LET B1=B2=B3=(N6/2/R)/(W1+W(N2,N3)+W2)
02140 PRINT "W(IJ)=";W(N2,N3); "W1=";W1; "W2=";W2
02150 PRINT
02160 PRINT

```



# POTENTIOMETERS (VARIABLE RESISTORS)

```

02170 PRINT"-----"
02180 FOR I=1TO6
02190 PRINT
02200 NEXT I
02210 PRINT TAB(13);VS(8)
02220 PRINT
02230 PRINT TAB(10);"RESISTANCE =";R,
02240 PRINT TAB(17);"ENVIRONMENT CODE =";Y8
02250 PRINT
02260 LET VS(1)="UPPER"
02270 LET VS(2)="LOWER"
02280 PRINT TAB(13);"GRADE OF RELIABILITY =";VS(C7)
02290 PRINT
02300 IF C9=0THEN2340
02310 PRINT TAB(5);"MULTIPLE OF LONGEVITY =";C8, "PI(L)=";C9
02320 PRINT
02330 LET N7=24
02340 FOR I=B2TOB1 STEP B3
02350 PRINT
02360 PRINT "STRESS RATIO =";I
02370 PRINT
02380 PRINT "TEMPERATURE", " FAILURE RATE (%/1000 HRS.)"
02390 PRINTTAB(15);"L(B)";TAB(30);"L(P)";TAB(50);"L(PL)"
02400 PRINT
02410 PRINT
02420 IF C7=2THEN2450
02430 LET H=H(Y-1)
02440 GOTO2470
02450 LET H=H(Y)
02470 FOR T=T2TOT1STEPT3
02480 LET N7=N7+1
02490 LET K=F(Y5)*EXP(((T+273)/A(Y5))*D(Y5))
02500 LET K=K*EXP(((1/B(Y5))*((T+273)/273)*C(Y5))*E(Y5))
02510 IF C9<>0THEN2540
02520 PRINT T, K, K*G1*K1*K3*H*N1,"NA"
02530 GOTO2550
02540 PRINT T,K,K*G1*K1*K3*H*N1,K*G1*K1*K3*H*N1*C9
02550 IF N7<60THEN2640
02600 LET N7=10
02610 FOR I4=1TO12
02620 PRINT
02630 IF I4<>6THEN2632
02631 PRINT"-----"
02632 NEXT I4
02640 NEXT T
02650 NEXT I
02651 IF N7=60THEN2660
02652 FOR I=N7TO66
02653 PRINT
02654 NEXT I
02655PRINT"-----"
02660 GOTO2680
02670 PRINT
02680 FOR I=1TO3

```

# POTENTIOMETERS (VARIABLE RESISTORS)

```

02690 PRINT
02700 NEXT I
02740 FOR I=1 TO 10
02750 PRINT
02760 NEXT I
02770 RESTORE
02780 RESTORES
02790 PRINT"ANOTHER ANALYSIS -- YES OR NO";
02800 INPUT US
02810 IF US<>"NO" THEN 2830
02820 GOTO 3270
02830 LET C9=0
02840 PRINT
02850 PRINT"SAME ENVIRONMENTS -- YES OR NO";
02860 INPUT US
02870 IF US="NO" THEN 0480
02880 LET Y8
02890 PRINT
02900 PRINT"SAME STRESS CONDITIONS -- YES OR NO";
02910 INPUT US(8)
02920 PRINT
02930 PRINT"SAME RESISTOR TYPE - YES OR NO";
02940 INPUT US(6)
02950 PRINT
02960 IF US(6)="NO" THEN 0530
02970 GOTO 0680
02980 DATA 1,0,0,0,0,0
02990 DATA 75,6,0,0,0,0,75,5,6,0,0,0,75,5,5,6,0,0
03000 DATA 75,5,4,5,6,0,75,5,4,4,5,6
03010 DATA 356,2.74,3.51,4.45,1.735E-5,355,1.44,4.46,5.28,1.358E-5
03020 DATA 373,2.32,5.3,9.3,1.616E-5,400,2.69,8.46,7.3,1.423E-4
03030 DATA 371,2.93,6.35,5.47,671,357E-5,371,2.92,6.35,5.47,671,139E-6
03040 DATA 377,1.47,2.83,4.66,1.481E-5
03050 DATA 1,5,2,4,5,25,8,40,10,50,10,50,15,60,120,600,150,750
03060 DATA 1,2,0,0,6,12,8,16,15,30,20,40,0,0,0,0,0,0
03070 DATA 1,5,0,0,10,50,40,200,50,250,50,250,60,300,0,0,100,500
03080 DATA 1,3,0,0,3,9,6,18,6,18,10,40,15,60,0,0,80,150
03090 DATA 1,3,0,0,3,9,6,18,6,18,8,32,12,48,0,0,60,120
03100 DATA 1,0,0,0,3,0,6,0,6,0,8,0,12,0,0,0,60,0
03110 DATA 1,2,0,0,6,12,8,16,15,30,20,40,0,0,0,0,0,0
03120 DATA 2,1,2,1,1,1,1,4,2,2,5,3,5,2,1,4,1,2,1,1,4,2
03130 DATA 1,5,1,1,1,1,1,1,2,1,4,1,8,2,7,1,4,1,1,1,1,2,1,4,1,3
03140 DATA 4,2,2,1,6,1,1,1,1,1,1,8,5,10,4,2,2,1,6,1,1,1,1,1,1,8,5,10
03150 DATA 2,1,4,1,2,1,1,4,2
03160 DATA 8,6,7,7,9,9,6
03170 DATA 19.998,49.998,1E4,2E4,5E4,1E5,2E5,5E5
03180 DATA 1.998,4.998,9.998,2E3,5E3,1E4
03190 DATA 19.998,199.998,5E4,1E5,2E5,5E5,1E6
03200 DATA 19.998,49.998,5E4,1E5,2E5,5E5,1E6
03210 DATA 19.998,49.998,99.998,199.99999,1E4,2E4,5E4,1E5,2E5
03220 DATA 19.998,49.998,99.998,199.998,1E4,2E4,5E4,1E5,2E5
03230 DATA 1.9989,4.9989,9.9989,2E3,5E3,10E3
03240 DATA 1,4,1,1,1,05,1,1,1,1,1,1,1,1,22,1,4,2
03250 DATA 1,2,1,1,1,1,1,1,1,1,1,1,1,05,1,2

```

POTENTIOMETERS (VARIABLE RESISTORS)

03260 DATA 4, 2, 1, 6, 3, 1.5, 1, 10, 50, 300  
03270 END

# CAPACITORS

```

00010 DIMS(10),FS(20),B(500),A(500),C(500)
00020 DIMX(15)
00030 PRINTTAB(15);"CAPACITOR FAILURE RATE"
00040 PRINT
00050 PRINT"DO YOU WISH INSTRUCTIONS -- YES OR NO?"
00060 INPUTFS(20)
00070 PRINT
00080 LET FS(1)="PAPER FOIL, PAPER MYLAR, PAPER, MYLAR-METALLIZED"
00090 LETFS(2)="MYLAR OR TEMLON"
00100 LETFS(3)="PLASTIC FILM (NON-METALLIC CASE)"
00110 LET FS(4)="POLYSTYRENE"
00120 LETFS(5)="TANTALUM FOIL"
00130 LETFS(6)="TANTALUM, WET SLUG"
00140 LETFS(7)="TANTALUM, SOLID, DIELECTRIC"
00150 LET FS(8)="ALUMINUM, WET FOIL"
00160 LET FS(9)="MICA, MOLDED"
00170 LETFS(10)="MICA, DIPPED"
00180 LETFS(11)="MICA, BUTTON"
00190 LETFS(13)="CERAMIC LOW K"
00200 LETFS(14)="CERAMIC, HIGH K"
00210 LETFS(15)="VARIABLE, CERAMIC"
00220 LETFS(16)="VARIABLE, GLASS PISTON"
00230 LETFS(12)="GLASS, PORCELAIN"
00240 IF FS(20) <> "YES" THEN 0670
00250 PRINT"THIS PROGRAM CALCULATES THE FAILURE RATE OF CAPACITORS IN"
00260 PRINT"ACCORDANCE WITH THE RADC RELIABILITY NOTEBOOK (SEPT 1967)."

```

# CAPACITORS

```

00540 PRINT
00550 PRINT "7"; TAB(11); "CAPACITANCE (UUF)"
00560 PRINT
00570 PRINT "8"; TAB(11); "MAX., MIN. AND INCREMENT OF STRESSES ---"
00580 PRINT TAB(11); "(STRESS RATIO AND OPERATING TEMPERATURE - DEG C)"
00590 PRINT
00600 PRINT TAB(11); "NOTE: IF ONLY ONE VALUE IS TO BE ENTERED FOR A STRE"
00610 PRINT TAB(11); " (THAT) VALUE FOR MAX, MIN AND INCREMENT"
00620 PRINT
00630 PRINT "DO YOU WISH TO RUN --- YES OR NO?"
00640 INPUT F3(19)
00650 PRINT
00660 IF F3(19) <> "YES" THEN 3050
00670 PRINT "INPUT ENVIRONMENT CODE"
00680 INPUT Y5
00690 PRINT
00700 PRINT "INPUT CAPACITOR TYPE CODE"
00710 INPUT A1
00720 PRINT
00730 PRINT "ANALYSIS FOR (1) UPPER OR (2) LOWER QUALITY GRADE?"
00740 PRINT "INPUT 1 OR 2"
00750 INPUT A7
00760 FOR I=1 TO 9
00770 READ S(I)
00780 NEXT I
00790 IF A1 <> 1 THEN 0820
00800 GOSUB 1590
00810 GOTO 0910
00820 IF A1 <> 7 THEN 0850
00830 GOSUB 1870
00840 GOTO 0910
00850 IF A1 <> 12 THEN 0880
00860 GOSUB 2140
00870 GOTO 0910
00880 FOR I=1 TO 32
00890 READ L,L,L
00900 NEXT I
00910 PRINT
00920 PRINT
00930 PRINT "INPUT MAX, MIN AND INCREMENT OF STRESS RATIO"
00940 INPUT B1, B2, B3
00950 PRINT
00960 PRINT "INPUT MAX, MIN AND INCREMENT OF OPER. TEMPERATURE (DEGREES"
00970 INPUT T1, T2, T3
00980 PRINT
00990 GOSUB 2390
01000 PRINT TAB(13); F3(A1); " CAPACITOR"
01010 PRINT
01020 PRINT "ENVIRONMENT CODE ="; Y5,
01030 IF A7=2 THEN 1060
01040 PRINT "UPPER GRADE"
01050 GOTO 1070
01060 PRINT "LOWER GRADE"
01070 PRINT

```

# CAPACITORS

```

01080 IF A1 <> 100 THEN 1110
01090 PRINT "RELIABILITY LEVEL =" ; S$ ; "CASE DIM. AND LENGTH (IN) =" ; X4 ; X
01100 GOTO 1170
01110 IF A1 <> 7 THEN 1150
01120 PRINT "RELIABILITY LEVEL =" ; S$ ; "CIRCUIT RES. (OHMS/VOLT) =" ; X
01130 PRINT
01140 GOTO 1170
01150 IF A1 <> 12 THEN 1170
01160 PRINT "RESISTOR STYLE =" ; S$ ; "CAPACITANCE (UUF) =" ; X3
01170 PRINT
01180 PRINT
01190 IF A1 = 1 THEN 1230
01200 FOR I = 1 TO (41 * (A1 - 1))
01210 READ D
01220 NEXT I
01230 FOR J = 1 TO 5
01240 READ A(J)
01250 NEXT J
01260 FOR I = 1 TO Y5
01270 READ B(1), B(2), C(1), C(2)
01280 NEXT I
01290 FOR B4 = B2 TO B1 STEP B3
01300 PRINT "STRESS RATIO =" ; B4
01310 PRINT
01320 PRINT "TEMPERATURE", "FAILURE RATE (%/1000HRS.)"
01330 PRINT " @ C" ; TAB(15) ; "L(B)" ; TAB(30) ; "L(P)"
01340 PRINT
01350 IF X1 <> 0 THEN 1370
01360 LET X1 = X2 = 1
01370 FOR T = T2 TO T1 STEP T3
01380 LET A6 = A(1) * ((B4 / A(2)) * A(3) + 1) * EXP(((T + T73) / A(4)) * A(5))
01390 PRINT T, A6, A6 * B(A7) * X1 * X2 + C(A7)
01400 NEXT T
01410 PRINT
01420 NEXT B4
01430 GOSUB 0390
01440 RESTORE
01450 RESTORE
01460 PRINT "ANOTHER ANALYSIS -- YES OR NO"
01470 INPUT S$
01480 IF S$ = "NO" THEN 1380
01490 PRINT
01500 PRINT "SAME ENVIRONMENT -- YES OR NO"
01510 INPUT S$
01520 PRINT
01530 IF S$ = "NO" THEN 0670
01540 PRINT "SAME CAPACITOR TYPE -- YES OR NO"
01550 INPUT S$
01560 IF S$ = "NO" THEN 0690
01570 GOTO 0720
01580 GOTO 0850
01590 PRINT "RELIABILITY LEVEL = (1) L, (2) M, (3) N, (4) R, OR (5) S"
01600 PRINT "INPUT 1, 2, 3, 4, OR 5"
01610 INPUT X1

```

# CAPACITORS

```

01620 LET S3=S3(X1)
01630 FOR I=1 TO 5
01640 READ X(I)
01650 NEXT I
01660 LET X1=X(X1)
01670 PRINT
01680 PRINT "INPUT CASE DIM. (IN) AND LENGTH (I) "
01690 INPUT X2,X3
01700 LET X4=X2
01710 FOR I=1 TO 9
01720 READ X(I)
01730 NEXT I
01740 LET X(9)=2
01750 FOR I=1 TO 8
01760 READ D,L
01770 IF X2=D THEN 1790
01780 GO TO 1800
01790 IF X3=L THEN 1820
01800 NEXT I
01810 LET I=I+1
01820 LET X2=X(I)
01830 FOR J7=1 TO 42
01840 READ D,L
01850 NEXT J7
01860 RETURN
01870 PRINT
01880 FOR I=1 TO 15
01890 READ X1,X1
01900 NEXT I
01910 READ X(1),X(2),X(3),X(4),X(5)
01920 PRINT "RELIABILITY LEVEL = (1) L, (2) N, (3) N, (4) R OR (5) S"
01930 INPUT X1
01940 LET S3=S3(X1)
01950 LET X1=X(X1)
01960 PRINT
01970 PRINT "CIRCUIT RESISTANCE (OHMS/VOLT) = "
01980 INPUT X2
01990 LET X3=X2
02000 FOR I=1 TO 8
02010 READ D,L
02020 IF X2=D THEN 2040
02030 NEXT I
02040 LET X2=L
02050 IF I=8 THEN 2090
02060 FOR J7=1+1 TO 8
02070 READ D,L
02080 NEXT J7
02090 FOR I=1 TO 9
02100 READ L,L,L,L,L
02110 NEXT I
02120 PRINT
02130 RETURN
02140 PRINT
02150 FOR I=1 TO 17

```

## CAPACITORS

```

02160 READ,L,L
02170 NEXTI
02180 PRINT"RESISTOR STYLE = (1) CY15, (2) CY15, (3) CY20 OR (4) CY30";
02190 INPUTL
02200 LETSS=SS(L+5)
02210 PRINT
02220 PRINT "CAPACTANCE (IN UUF) ="
02230 INPUTX1
02240 LETX2=1
02250 LETX3=X1
02260 FORI=1TO9
02270 READR(1),X(2),X(3),X(4),D
02280 IFJ7<>0THEN2320
02290 IFX1>X(L)THEN2320
02300 LETJ7=1
02310 LETX1=D
02320 NEXTI
02330 IFX1<>0THEN2350
02340 PRINT"THE MULT.FACTOR FOR THIS STYLE AND CAP = NA, TRY AGAIN"
02350 RESTORE
02360 RESTORES
02370 GOTO6760
02380 RETURN
02390 FORI=1TO6
02400 PRINT
02410 NEXTI
02420 PRINT";!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!"
02430 FORI=1TO6
02440 PRINT
02450 NEXTI
02460 RETURN
02470 DATA,N,N,R,S,CY10,CY15,CY20,CY30
02480 DATA 3,1,.3,.1,.03,.2,.2,.2,.3,.3,1,1,1,2
02490 DATA .275,.75,.312,.575,.4,.575,.4,1.375,.562,1.625,.67,1.625
02500 DATA .75,2.125,.78,2.375
02510 DATA3,1,.3,.1,.03,.1,1,.2,.8,.4,.6,.6,.4,.8,.3,1,.2,2,.1,3,.27
02520 DATA10,0,0,0,.2,20,240,650,0,.4,30,360,1000,0,.6
02530 DATA39,470,1300,4300,.8,47,560,1000,5600,1,100,650,3600,10000,2
02540 DATA 150,820,5100,0,3,200,910,0,0,4,300,1200,0,0,5
02550 DATA 1E-5,.4,5,379,20,1,10,0,1E-4,1,1,10,1E-5,1E-4,2,20,2E-5,2E-4
02560 DATA 4,40,1E-4,1E-3,4,40,1E-4,1E-3,4,40,1E-4,1E-3,15,150,5E-4,5E-3
02570 DATA 18,180,6E-4,6E-3,20,200,1E-3,1E-2
02580 DATA202E-5,.78,5,377,20,6,1,6,0,5E-5,11E-1,6,5E-4,5E-3,2,12,.001,0
02590 DATA4,24,.002,.02,4,24,.002,.02,4,24,.002,.02,15,90,.05,.08
02600 DATA16,100,.008,.008,20,120,.01,.1
02610 DATA 32E-5,.73,5,370,17,4,1,5,0,.0005,1,1,5,1E-4,.001
02620 DATA2,10,2E-4,.002,4,20,5E-4,.005,4,20,5E-4,.005,4,20,5E-4,.005
02630 DATA15,75,.002,.02,18,90,.003,.03,20,100,.003,.03
02640 DATA438E-9,.68,5,40,1,.2,1,0,1E-4,.22,1,1,2E-5,2E-4
02650 DATA .4,2,4E-5,4E-4,.8,4,.0001,.001,.8,4,1E-4,.001
02660 DATA .8,4,1E-4,1E-3,3,15,4E-4,4E-3,3,6,10,.0005,.005,4,10,6E-4,6E-3
02670 DATA13E-4,.52,3,358,8,8,1,5,0,.001,1,1,5,2E-4,2E-3
02680 DATA2,10,.0004,.003,6,30,12E-4,12E-3,6,30,12E-4,12E-3,6,30,12E-4,0
02690 DATA20,100,4E-3,.04,25,125,.005,.05,30,150,.006,.06

```



# CAPACITORS

```

02700 DATA17E-4, .32, 3, 369, 9.6, .1, 1, 0, 5E-4, .11, 1, 1, .0005, .005, .2, 2, .001, 0
02710 DATA, 4, 4, 2E-3, .02, .4, 4, 2E-3, .02, .4, 4, 2E-3, .02, 1.5, 15, 8E-3, .06
02720 DATA2, 20, .01, .1, 3, 30, .15E-1, .15
02730 DATA574E-6, .4, 3, 381, 14, 3, 1, 10, 0, 5E-4, 1, 1, 10, 5E-5, 5E-4
02740 DATA2, 20, 1E-4, 1E-3, 4, 40, 2E-4, 2E-3, 4, 40, 2E-4, 2E-3, 4, 40, 2E-4, 2E-3
02750 DATA 15, 150, .0005, 5E-3, 18, 180, 9E-4, 9E-3, 20, 200, 1E-3, .01
02760 DATA 418E-6, .55, 3, 288, 5.9, 1, 10, 0, 2E-3, 1, 1, 10, 5E-4, 2E-3
02770 DATA2, 20, 5E-4, 2E-3, 12, 60, 3E-3, .01, 12, 60, 3E-3, .01, 12, 60, 3E-3, .01
02780 DATA30, 160, 8E-3, .03, 35, 180, .01, .04, 40, 200, .012, .05
02790 DATA, 526 E-10, .37, 3, 25, 1, 1, 5, 0, 5E-5, 2, 10, 1E-5, 1E-4, 4, 20, 2E-5, 2E-4
02800 DATA6, 40, 3E-5, 3E-4, 6, 40, 3E-5, 3E-4, 6, 40, 3E-5, 3E-4, 24, 120, 12E-5, 12E-4
02810 DATA 16, 130, 13E-5, 13E-4, 30, 150, 15E-5, 15E-4
02820 DATA831E-13, .37, 3, 15, 1, 1, 5, 0, 5E-5, 2, 10, 1E-5, 1E-4, 4, 20, 2E-5, 2E-4
02830 DATA6, 40, 3E-5, 3E-4, 6, 40, 3E-5, 3E-4, 6, 40, 3E-5, 3E-4
02840 DATA 24, 120, 12E-5, 12E-4, 26, 130, 13E-5, 13E-4, 30, 150, 15E-5, 15E-4
02850 DATA 53E-5, .4, 3, 348, 6.3
02860 DATA1, 5, 0, .0002, 2, 10, .0003, .0015, 4, 20, .0006, .003, 6, 40, .001, .007
02870 DATA6, 40, .001, .007, 6, 40, .001, .007, 24, 160, .004, .03, 26, 170, .004, .03
02880 DATA 30, 180, .005, .04
02890 DATA 195E-12, .51, 3, 25, 1, 1, 5, 0, 5E-5, 2, 10, 1E-5, 1E-4, 4, 20, 2E-5, 2E-4
02900 DATA6, 40, 3E-5, 3E-4, 6, 40, 3E-5, 3E-4, 6, 40, 3E-5, 3E-4, 24, 120, 12E-5, 12E-4
02910 DATA26, 130, 13E-5, 13E-4, 30, 150, 15E-5, 15E-4
02920 DATA 361E-12, .3, 3, 25, 1, 1, 10, 0, 5E-5, 2, 20, 1E-5, 1E-4, 4, 4, 2E-5, 2E-4
02930 DATA6, 60, 3E-5, 3E-4, 6, 60, 3E-5, 3E-4, 6, 60, 3E-5, 3E-4, 24, 240, 12E-5, 12E-4
02940 DATA26, 260, 13E-5, 13E-4, 30, 300, 15E-5, 15E-4
02950 DATA 84E-6, .3, 3, 342, 6.7, 1, 10, 0, 5E-4, 1, 1, 10, 5E-5, 5E-4
02960 DATA 2, 20, 1E-4, 1E-3, 4, 40, 2E-4, 2E-3, 4, 40, 2E-4, 2E-3, 4, 40, 2E-4, 2E-3
02970 DATA10, 100, .0006, 5E-3, 12, 120, 6E-4, 6E-3, 15, 150, 8E-4, 8E-3
02980 DATA 15E-5, .17, 3, 342, 10, 1, 1, 20, 0, 4E-3, 2, 40, 2E-4, 4E-3
02990 DATA4, 60, 4E-4, 5E-3, 6, 160, 1E-3, .02, 6, 160, 1E-3, .02, 6, 160, 1E-3, .02
03000 DATA50, 1000, .01, .2, 60, 1200, 15E-3, .3, 70, 1400, .02, .4
03010 DATA146E-9, .33, 3, 33, 1, 1E-1, 1, 0, 15E-4, 15E-2, 1.5, 15E-5, 15E-4
03020 DATA .3, 3, 3E-4, 3E-3, 1, 10, 1E-3, .01, 1, 10, .001, .01, 1, 10, .001, .01
03030 DATA5700, 5E-3, .05, 10, 100, .01, .1, 12, 120, .012, .12
03040 RETURN
03050 END

```

# CONNECTORS

```

00010 DIMA(10),B(10),C(10),D(10),E(10),H(18),U$(20)
00020 GOSUB 1530
00030 PRINTTAB(15);"CONNECTOR FAILURE RATE"
00040 PRINT
00050 PRINT"INSTRUCTIONS -- YES OR NO";
00060 INPUTU$
00070 PRINT
00080 IFU$<>"YES"THEN0540
00090 PRINT"THIS PROGRAM CALCULATES THE BASE FAILURE RATE AND THE FAILURE
00100 PRINT"OF CONNECTORS IN ACCORDANCE WITH THE RADC RELIABILITY NOTES
00110 PRINT" SEPT 1967."
00120 PRINT
00130 PRINTTAB(15);"INPUT REQUIREMENTS AND CODES"
00140 PRINT
00150 PRINT"1";TAB(11);"ENVIRONMENT "
00160 PRINT
00170 PRINTTAB(11);"(1) LABORATORY, (2) GROUND, FIXED, (3) GROUND PORTABLE
00180 PRINTTAB(11);"(4) GROUND, MOBILE, (5) AIRBORNE, INHABITED,"
00190 PRINTTAB(11);"(6) AIRBORNE, UNINHABITED, (7) SATELLITE ORBIT"
00200 PRINTTAB(11);"(8) SATELLITE LAUNCH, (9) MISSILE"
00210 PRINT
00220 PRINT"2";TAB(11);"CONNECTOR IDENTIFIER"
00230 PRINT
00240 PRINTTAB(11);"(ONLY FOR IDENTIFICATION -- NOT USED FOR CALCULATIONS
00250 PRINT
00260 PRINT"3";TAB(11);"RELIABILITY GRADE -- UPPER OR LOWER"
00270 PRINT
00280 PRINT"4";TAB(11);"MATERIAL -- (1) A, (2) B, (3) C, (4) D"
00290 PRINT
00300 PRINT"5";TAB(11);"EXPECTED CURRENT (AMPS)"
00310 PRINT
00320 PRINT"6";TAB(11);"NUMBER OF ACTIVE PINS"
00330 PRINT
00340 PRINT"7";TAB(11);"CYCLES/1000 HRS."
00350 PRINT
00360 PRINT"8";TAB(11);"MAX, MIN AND INCREMENT OF AMBIENT TEMPERATURE"
00370 PRINTTAB(11);"(DEGREES C)"
00380 PRINT
00390 PRINT"9";TAB(11);"PIN GAGE -- (1) 22, (2) 20, (3) 16, (4) 12"
00400 PRINT
00410 PRINT"NOTES:"
00411 PRINT
00412 PRINTTAB(11);"CODES = NUMBERS IN BRACKETS ( )"
00420 PRINT
00430 PRINTTAB(11);"IF ONLY ONE VALUE FOR AMBIENT TEMPERATURE IS TO"
00440 PRINTTAB(11);"ENTERED, INPUT THAT VALUE FOR MAX, MIN AND INCREMENT"
00450 PRINT
00460 PRINTTAB(11);"INPUTS TO THIS PROGRAM ARE ENTERED THROUGH THE KEYBOARD
00470 PRINTTAB(11);"THEY ARE QUERIED."
00480 PRINT
00482 PRINTTAB(11);"MANY OUTPUTS ARE IN ACCORDANCE WITH THE INPUT CODES"
00490 PRINT
00500 PRINT"RUN -- YES OR NO";
00510 INPUTU$

```

# CONNECTORS

```

00520 IFUS="NO"THEN1650
00530 GO SUB1530
00540 PRINT"INPUT:"
00550 PRINT
00560 PRINT"ENVIRONMENT CODE = ??? (1) LAB, (2) GF, (3) GP, (4) GM,"
00570 PRINT"(5) AI, (6) AU, (7) SO, (8) SL OR (9) M -- INPUT 1,2,.... @
00580 INPUT Y5
00600 PRINT
00610 PRINT"CONNECTOR IDENTIFIER =";
00620 INPUTU5(4)
00630 PRINT
00640 PRINT"(1) UPPER OR (2) LOWER GRADE -- INPUT 1 OR 2";
00650 INPUT Y3
00655 LETY5=Y5*2
00660 PRINT
00670 FORI=1TO18
00680 READH(I)
00690 NEXTI
00700 IFY3=2THEN00725
00710 LETH=H(Y5-1)
00720 GOTO00730
00725 LETH=H(Y5)
00730 LETY5=Y5/2
00740 IFU5(3)="YES"THEN00910
00760 PRINT"MATERIAL = ? (1) A, (2) B, (3) C OR (4) D";
00770 INPUTJ1
00780 PRINT
00790 PRINT"EXPECTED CURRENT (AMPS)=";
00800 INPUTJ3
00810 PRINT
00820 PRINT"NUMBER OF ACTIVE PINS AND CYCLES/1000HRS.";
00830 INPUTJ4,J5
00840 PRINT
00850 PRINT"PIN GAGE = (1) 22, (2) 20, (3) 16, OR (4) 12";
00860 INPUTJ6
00870 PRINT
00880 IFU5(5)="YES"THEN00910
00890 PRINT"MAX, MIN AND INCREMENT OF AMBIENT TEMPERATURE (DEGREES C)=";
00900 INPUTT2,T1,T3
00910 FORI=1TO4
00920 READ A(I),B(I),C(I),D(I),E(I)
00930 NEXTI
00940 FORI=1TO4
00950 IFI>J6GOTO0980
00960 READX1,Y1,X2,Y2
00970 GOTO0990
00980 READ Y,Y,Y,Y
00990 NEXTI
01000 LETY=(LOG(Y2)-LOG(Y1))*(LOG(J3)-LOG(X2))/(LOG(X2)-LOG(X1))
01010 LET Y=Y+LOG(Y2)
01020 LETY=EXP(Y)
01030 IFJ5<10THEN1050
01040 LET C=J4*.0001*EXP(J5/100)
01050 LETP=EXP((J4/10)+.545)

```

# CONNECTORS

```

01060 GOSUB1530
01070 PRINT
01080 PRINTTAB(17);US(4);" CONNECTOR"
01090 LETUS(1)="UPPER"
01100 LETUS(2)="LOWER"
01110 PRINT
01120 PRINTTAB(10);"MATERIAL CODE =" ;J1;SPC(12);"PIN GAGE CODE =" ;J6
01130 PRINT
01140 PRINTTAB(10);US(Y3);" GRADE";SPC(10);"ENVIRONMENT CODE =" ;Y5
01150 PRINT
01160 PRINT"NUMBER OF ACTIVE PINS =" ;J4;SPC(15);"CYCLES =" ;J5
01170 PRINT
01180 PRINTTAB(17);"EXPECTED CURRENT =" ;J3;" AMPS"
01190 PRINT
01200 PRINTTAB(7);"TEMPERATURE";SPC(12);"FAILURE (%/1000 HR.)"
01210 PRINT
01220 PRINT"A(1)=" ;A(J1);"B(1)=" ;B(J1);"C(1)=" ;C(J1);"D(1)=" ;D(J1)
01230 PRINT"E(1)=" ;E(J1);"Y=" ;Y;"C=" ;C;"H=" ;H;"P=" ;P
01240 PRINT"AMBIENT","OPERATING","L(B)","L(C0)"
01250 PRINT
01260 FOR T=T1 TO T2STEP T3
01270 LETY1=Y
01280 LET Y1=Y1+T+273
01290 LETY4=(1/(Y1/C(J1)))+(Y1/E(J1))*D(J1)
01300 LET J9=A(J1)*EXP(Y4)
01310 LET Y1=Y1-273
01320 PRINTT,Y1,J9,J9*H*P+C
01330 NEXTT
01340 LETC=0
01350 RESTORE
01360 GOSUB 1530
01370 PRINT"ANOTHER ANALYSIS -- YES OR NO"
01380 INPUTUS(3)
01390 IFUS(3)="NO"THEN1650
01400 PRINT
01410 PRINT"SAME AMBIENT TEMPERATURE -- YES OR NO"
01420 INPUT US(5)
01430 PRINT"SAME ENVIRONMENT -- YES OR NO"
01440 INPUT US(3)
01450 IFUS(3)="NO"THEN 0550
01460 PRINT
01470 PRINT"SAME CONNECTOR -- YES OR NO"
01480 INPUTUS(3)
01490 IF US(3)="NO"THEN0600
01500 PRINT
01510 GOTO0640
01520 GOTO1650
01530 FORI=1TO6
01540 PRINT
01550 NEXTI
01560 PRINT"-----"
01570 FORI=1TO6
01580 PRINT
01590 NEXTI

```

# CONNECTORS

01600 RETURN

01610 DATA 1, 10, 3, 12, 4, 15, 8, 16, 4, 15, 10, 20, 2, 10, 15, 30, 15, 30

01620 DATA 324E-5, -1, -1592, 5, 36, 473, .069, -1, -2073, 4, 66, 423

01630 DATA .018, -1, -1298, 425E-2, 373, .123, -1, -1528, 8, 4, 72, 358

01640 DATA 4, 13, 7, 36, 5, 12, 8, 30, 7, 10, 20, 70, 15, 15, 40, 70

01650 END

# RELAYS

```

00010 DIMX(10),Y(20),US(10),ZS(10),H(40),J(40),K(10)
00020 DIM A(3),B(3),C(3),L(5),ES(10)
00030 GO SUB2280
00040 PRINTTAB(15);"FAILURE RATES OF RELAYS"
00050 PRINT
00060 PRINT"INSTRUCTION -- YES OR NO";
00070 INPUT US
00080 IFUS<>"YES"THEN0530
00085 PRINT
00090 PRINT "THIS PROGRAM CALCULATES THE BASE FAILURE RATE AND THE"
00100 PRINT"FAILURE RATE OF RELAYS IN ACCORDANCE WITH THE RADC RELIABILITY"
00110 PRINT"NOTEBOOK (SEPT 1967)."

```

# RELAYS

```

00510 INPUTUS
00520 IFUS="NO" THEN 2520
00530 PRINT
00535 GOSUB 02250
00540 PRINT "ENVIRONMENT = ??? (1) LAB, (2) SO, (3) GF, (4) GP, (5) A
00550 PRINT"(6) GM, (7) AU, (8) SL, OR (9) M --- INPUT 1,2,.....9";
00560 INPUT Y5
00570 PRINT
00580 PRINT "CONTACT FORM AND QUALITY = ??? (1) SPST, (2) DPST, (3) S
00590 PRINT "(4) 3PST, (5) 4PST, (6) DPDT, (7) 3PDT, (8) 4PDT OR (9)
00600 PRINT "INPUT 1,2,.....,OR9";
00610 INPUT X1
00620 PRINT
00630 PRINT "PART IDENTIFIER =";
00640 INPUTUS(10)
00650 PRINT
00660 PRINT "GRADE OF RELIABILITY = ??? (1) UPPER OR (2) LOWER -- INP
00670 INPUT X2
00680 PRINT
00690 PRINT "CYCLES/HR=";
00700 INPUTC
00710 PRINT
00720 FOR I=1 TO 18
00730 READ Y(I)
00740 NEXT I
00750 IF X2=2 THEN 0780
00760 LET G=(Y(Y5+2)-1)
00770 GO TO 0790
00780 LET G=Y(Y5+2)
00790 PRINT
00800 PRINT "LOAD TYPE = ? (1) RESISTIVE, (2) INDUCTIVE OR (3) LAMP"
00810 PRINT "INPUT 1,2 OR 3";
00820 INPUT X3
00830 PRINT
00840 PRINT "TEMPERATURE RATING = (1) 55 OR (2) 125 DEGREES - INPUT 1
00850 INPUT T4
00860 PRINT
00870 IF E3(2)="YES" THEN 0950
00880 PRINT "MAX, MIN AND INCREMENT OF OPERATING TEMPERATURE"
00890 PRINT "(DEGREES C) =";
00900 INPUT T2, T1, T3
00910 PRINT
00920 PRINT "MAX, MIN AND INCREMENT OF STRESS RATIO (LOAD/RATED RES.
00930 INPUT S2, S1, S3
00940 PRINT
00950 LET L(1)=.8
00960 LET L(2)=.4
00970 LET L(3)=.2
00980 FOR I=1 TO 9
00990 READ X(I)
01000 NEXT I
01010 FOR I=1 TO 37
01020 READ H(I), J(I)
01030 NEXT I

```

# RELAYS

```

01040 LET C1=1
01050 IFC<1 THEN 1100
01060 LET C1=C/10
01070 IF X1=1 THEN 1100
01080 IFC<1000 THEN 1100
01090 LET C1=C/2
01100 LET J2=0
01110 PRINT "CONTACT RATING = ?? (1) SIGNAL CURRENT, (2) 0-5 AMPS, (3) 50
01120 PRINT "OR (4) 25-600 AMPS --- INPUT 1,2,3 OR 4"
01130 LET S(7)="SIGNAL CURRENT"
01140 LET S(8)="0-5 AMPS"
01150 LET S(9)="5-20 AMPS"
01160 LET S(10)="25-600 AMPS"
01170 PRINT
01180 INPUT Y6
01190 IF Y6<1 THEN 1240
01200 IF Y6<4 THEN 1240
01210 PRINT
01220 PRINT "APPLICATION TYPE=?????"
01230 PRINT
01240 FOR I=1 TO 4
01250 READ Y7
01260 FOR J1=1 TO Y7
01270 READ U6
01280 IF I<>Y6 THEN 1340
01290 LET Z6(J1)=U6
01300 IF J3=1 THEN 1340
01310 READ K(J1)
01320 PRINT "( " J1 " ) " U6
01330 GO TO 1390
01340 READ Y8
01350 IF I>Y6 THEN 1380
01360 LET Y9=Y9+Y8
01370 GO TO 1390
01380 LET Y4=Y4+Y8
01390 NEXT J1
01400 NEXT I
01410 LET J3=1
01420 IF Y6=1 THEN 1570
01430 IF Y6<>4 THEN 1480
01440 GO TO 1580
01450 PRINT
01460 PRINT "INPUT 1,2,3,..."
01470 INPUT J3
01480 IF J3=1 THEN 1580
01490 FOR I=1 TO (J3-1)
01500 LET Y9=Y9+K(I)
01510 NEXT I
01520 FOR I=1 TO Y9
01530 READ U6
01540 NEXT I
01570 PRINT
01580 PRINT "CONSTRUCTION TYPE ="
01590 PRINT

```



# RELAYS

```

01600 FORI=1TOK(J3)
01610 READUS(I)
01620 PRINT "(";I;")",US(I)
01630 NEXTI
01640 IF I=1THEN1680
01650 PRINT
01660 PRINT"INPUT 1,2,...";
01670 INPUTJ3
01680 PRINT
01690 IFX2=2THEN1720
01700 LETH1=H(Y9+J3)
01710 GOTO1730
01720 LETH1=J(Y9+J3)
01730 IFY6=4THEN1770
01740 FORI=1TOY4
01750 READUS
01760 NEXTI
01770 FORI=1TO2
01780 READA(I),B(I),C(I)
01790 NEXTI
01800 GOSUB2280
01810 PRINTTAB(17);US(10);SPC(4);"RELAY"
01820 PRINT
01830 PRINT"ENVIRONMENT CODE=";Y6;"CONTACT RATING =";ES(Y6+6)
01840 PRINT
01850 PRINT"CONSTRUCTION TYPE =";US(J3);SPC(4);
01860 LETUS(1)="UPPER"
01870 LETUS(2)="LOWER"
01880 PRINT"GRADE OF RELIABILITY =";US(X8)
01890 PRINT
01895 LETSS=9
01900 FORS=31TO32STEPS3
01910 PRINT
01920 PRINT "STRESS RATIO =";S
01930 PRINT
01935 LETSS=SS+8
01940 PRINT "TEMPERATURE";SPC(18);"FAILURE RATE (1/1000HRS)"
01950 PRINTTAB(15);"L(B)", "L(R)"
01960 PRINT
01970 FORT=T1TOSTEPT3
01980 PRINTT(A(T4)*EXP((T+273)/B(T4));C(T4)),
01990 PRINTA((T4)*EXP((T+273)/B(T4));C(T4))*EXP((S/L(X3));B)*H1*X(X1)
01994 LETSS=SS+1
01995 IFSS=60 THEN 02000
01996 GOSUB02000
02000 NEXTT
02030 NEXTS
02031 IFSS=60THEN02041
02035 FORI=SS+1TO60
02036 PRINT
02037 NEXTI
02040 PRINT
02041 GOSUB02000
02042 LETY9=Y4=0

```

# RELAYS

```

02045 PRINT "A=";A(T4),"B=";B(T4),"C=";C(T4);EXP((S/L(X3))*.2)
02046 PRINT "H1=";H1,"C1=";C1,"G=";G,"X=";X(X1)
02050 GOTO 2360
02060 DATA 2,1.5,3,2,4,8,20,8,16,10,30,12,30,55,150,100,300,1,1.5,1.75
02070 DATA 2,2,3,4,25,5,5,8,4,12,2,6,1,3,6,12,7,14,7,14,3,6,5,10,6,12
02080 DATA 5,15,2,,6,8,20,100,100,10,30,10,30,100,100,2,6,1,3,25,0
02090 DATA 2,0.50,100,9,12,10,20,5,10,5,10,20,40,10,20,3,9,1,3,2,6,3,9
02100 DATA 2,4,2,6,7,14,12,24,10,20,5,10
02110 DATA 1, DRY CIRCUIT, 6, 8, GENERAL PURPOSE, 3, SENSITIVE (0=100MW), 5
02120 DATA POLARIZED, 2, VIBRATING REED, 2, HIGH SPEED, 2, THERMAL TIME DELAY
02130 DATA 1, ELECTRONIC TIME DELAY, 1, LATCHING (MAGNETIC), 3
02140 DATA 2, HIGH VOLTAGE, 2, MEDIUM POWER, 6, 1, CONTRACTORS (HIGH CURRENT), 4
02150 DATA ARMATURE (LONG), DRY REED, MERCURY WETTED, MAGNETIC LATCHING
02160 DATA BALANCED ARMATURE, SOLENOID
02170 DATA ARMATURE (LONG), BALANCED ARMATURE, SOLENOID
02180 DATA ARMATURE (LONG & SHORT), MERCURY WETTED, MAGNETIC LATCHING
02190 DATA METER MOVEMENT, BALANCED ARMATURE, ARMATURE (SHORT)
02200 DATA METER MOVEMENT, DRY REED, MERCURY WETTED
02210 DATA ARMATURE (BALANCED AND SHORT), DRY REED, BIMETAL
02220 DATA SOLID STATE, DRY REED, MERCURY WETTED, BALANCED ARMATURE
02230 DATA VACUUM (GLASS), VACUUM (CERAMIC), ARMATURE (LONG AND SHORT)
02240 DATA MERCURY WETTED, MAGNETIC LATCHING, MECHANICAL LATCHING
02250 DATA BALANCED ARMATURE, SOLENOID, ARMATURE (SHORT), MECHANICAL LATCHING
02260 DATA BALANCED ARMATURE, SOLENOID
02270 DATA 11E-6, 352, 15.7, 100E-6, 377, 10.4
02280 FOR I=1 TO 6
02290 PRINT
02300 NEXT I
02305 LET S=0
02310 PRINT "*****"
02320 FOR I=1 TO 6
02330 PRINT
02340 NEXT I
02350 RETURN
02360 PRINT "ANOTHER ANALYSIS -- YES OR NO?"
02370 INPUT E
02380 IF E="NO" THEN 2500
02390 RESTORE
02400 RESTORE
02410 PRINT
02420 PRINT "SAME TEMP AND STRESS RATIO"
02430 INPUT E(2)
02440 PRINT
02450 PRINT "SAME ENVIRONMENT -- YES OR NO?"
02460 INPUT E
02470 IF E="NO" THEN 2530
02480 PRINT "SAME CONTACT FORM AND QUALITY -- YES OR NO?"
02490 INPUT E
02500 IF E="NO" THEN 2570
02510 GOTO 2620
02520 END

```

# SWITCHES

```

00010 DIMA(10),B(10),C(10),D(10),X(10),ZS(10),US(10)
00020 GOSUB2110
00030 PRINT TAB(15);"FAILURE RATES FOR SWITCHES"
00040 PRINT
00050 PRINT"INSTRUCTIONS -- YES OR NO"
00060 INPUTUS
00070 PRINT
00080 PRINT
00090 IFUS<="YES"THEN0680
00100 PRINT"THIS PROGRAM CALCULATES THE FAILURE RATE OF SWITCHES IN ACCO
00110 PRINT"WITH THE RADC RELIABILITY NOTEBOOK, SEPT. 1967.
00120 PRINT
00130 PRINT TAB(15);"INPUT REQUIREMENTS AND CODES"
00140 PRINT
00150 PRINT"1)"TAB(11);"ENVIRONMENT & CODE"
00160 PRINT
00170 PRINTTAB(11);"(1) LABORATORY, (2) SATELLITE ORBIT, (3) GROUND FIXE
00180 PRINT
00190 PRINTTAB(11);"(4) GROUND PORTABLE, (5) AIRBORNE INHABITES,"
00200 PRINT
00210 PRINT TAB(11);"(6) GROUND MOBILE, (7) SATELLITE LAUNCH"
00220 PRINT
00230 PRINT
00240 PRINT"2)"TAB(11);"RELIABILITY GRADE -- (1) UPPER, (2) LOWER OR (3)
00250 PRINT
00260 PRINT
00270 PRINT "3)"TAB(11);"MAX., MIN. AND INCREMENT OF SWITCHING CYCLES/HR
00280 PRINT
00290 PRINT
00300 PRINT
00310 PRINT"4)"TAB(11);"SWITCH DESCRIPTION -- (1) TOGGLE OR PUSHBUTTON"
00320 PRINTTAB(11);"(2) BASIC SENSITIVE SWITCH"
00330 PRINTTAB(11);"(3) SINGLE BODY OR MULTIPLE GROUPS,"
00340 PRINTTAB(11);"(4) ACTUATION ASSEMBLY (USING BASIC SENSITIVE"
00350 PRINTTAB(11);"SWITCH OR ROTARY WAFERS), (5) ROTARY SWITCH WAFERS"
00360 PRINT
00370 PRINT
00380 PRINT"5)"TAB(11);"SWITCH TYPE - 1 SNAP ACTION, 2 NON-SNAP ACTION"
00390 PRINTTAB(11);"3 ACTUATION DIFFERENTIAL >.002 IN., "
00400 PRINTTAB(11);"4 ACTUATION DIFFERENTIAL <.002 IN.,"
00410 PRINT TAB(11);"5 CERAMIC RF WAFERS, 6 MEDIUM POWER WAFERS"
00420 PRINT
00430 PRINT
00440 PRINT"6)"TAB(11);"NUMBER OF CONTACTS, ACTIVE SWITCHES OR"
00450 PRINT TAB(11);"BASIC SENSITIVE SWITCHES."
00460 PRINT
00470 PRINT
00480 PRINT"NOTES:"
00490 PRINT
00500 PRINT"THE NUMBERS IN BRACKETS (X) ARE THE CODES."
00510 PRINT
00520 PRINT "THE CODES FOR THE SWITCH TYPE ARE NOT CONSTANT FOR EVERY RM
00530 PRINT
00540 PRINT"IF ONLY ONE VALUE IS TO BE ENTERED FOR THE CYCLES/HR."

```

# SWITCHES

```

00550 PRINT"INPUT THAT VALUE FOR MAX, MIN AND INCREMENT"
00560 PRINT
00570 PRINT "MANY OF THE OUTPUTS ARE IN ACCORDANCE WITH THE INPUT CODES"
00580 PRINT
00590 PRINT"DO YOU WISH TO RUN -- YES OR NO"
00600 INPUT$
00610 GOSUB2110
00615 IF$="YES"THEN02200
00620 PRINT "ENVIRONMENT = (1) LAB, (2) SO, (3) GF, (4) GP, (5) AI,"
00630 PRINT"(6) GM, OR (7) SL -- INPUT 1,2,...,7"
00640 INPUT$
00650 IF$(2)="YES"THEN0700
00660 PRINT
00670 PRINT"RELIABILITY GRADE = (1) UPPER, (2) LOWER OR (3) BOTH --"
00680 PRINT"INPUT 1,2 OR 3"
00690 INPUT$
00700 PRINT
00710 RESTORE
00720 RESTORE$
00730 PRINT"MAX, MIN AND INCREMENT OF SWITCHING CYC/HR ="
00740 INPUT $2,$1,$3
00750 PRINT
00760 IF$2="1"THEN0780
00770 LET$1=1
00780 PRINT
00790 PRINT"SWITCH DESCRIPTION ="
00800 FORI=1TO4
00810 READ$1
00820 PRINTTAB(1);I;$1
00830 NEXT I
00840 PRINT
00850 PRINT "INPUT 1,2,3 OR 4"
00860 INPUT$3
00870 PRINT
00880 FORI=1TO6
00890 READ$1
00900 NEXT I
00910 FOR I=1TO6
00920 READA(I),B(I),C(I),X(I)
00930 NEXTI
00940 READX(7)
00950 LETK1=.04
00960 FORI=1TO9
00970 READD(I)
00980 NEXTI
00990 IF$3="3"THEN1110
01000 PRINT
01010 PRINT "USING:"
01020 PRINT
01030 FORI=3TO6
01040 PRINTI;SPC(4);Z$1
01050 NEXT I
01060 PRINT
01070 PRINT "INPUT 3,4,5, OR 6"

```

# SWITCHES

```

01080 INPUTX4
01090 PRINT
01100 GOTO1270
01110 LETX4=2*X3
01120 IFX4<>8THEN1140
01130 LETX4=X4-2
01140 PRINT"SWITCH TYPE = (1)";SPC(2);Z$(X4-1); SPC(2);"OR (2)";SPC(2);#
01150 PRINT"INPUT 1 OR 2"
01160 INPUTX5
01170 IFX4>4THEN1240
01180 PRINT
01190 PRINT"CONTACT FORM AND QUALITY = (1)SPST, (2) DPST, (3) SPDT,"
01200 PRINT"(4) 3PST, (5) 4PST, (6) DPST, (7) 3PDT, (8) 4PDT,"
01210 PRINT"OR (9) 6PDT --- INPUT 1,2,3,.... 9"
01220 INPUTX1
01230 GOTO1250
01240 LET X1=1
01250 IFX5=2THEN1270
01260 LETX4=X4-1
01270 LETH1=B(X4)
01280 LETH2=C(X4)
01290 IFX3=3THEN1340
01300 PRINT
01310 PRINT"NUMBER OF CONTACTS/ACTIVE POLES/BASIC SEN. SW. =
01320 INPUTN
01330 PRINT
01340 IFX2=3THEN1390
01350 IFX2=2THEN1380
01360 LETH3=1
01370 GOTO1390
01380 LETH1=1
01390 GOSUB 2110
01400 IFX3=2THEN1450
01410 LETN=1
01420 LET A1=A(X4)*X(Y5)*D(X1)*N
01430 LETA2=A1*H1
01440 LETA3=A1*H2
01450 LETS6=18
01460 PRINT TAB(15);US(X3);SPC(2);"SWITCH"
01470 PRINT
01480 PRINT "TYPE ="Z$(X4);SPC(4);"CONTACT FORM AND QUANTITY CODE ="JDE
01490 PRINT
01500 LETU$(7)="UPPER"
01510 LETU$(8)="LOWER"
01520 LETU$(9)="UPPER AND LOWER"
01530 PRINT"ENVIRONMENT CODE="Y5;SPC(3);"RELIABILITY GRADE ="Y5(X2+6)
01540 PRINT
01550 PRINT"NUMBER OF CONTACTS/ACTIVE POLES/BASIC SENS. SW. ="
01560 PRINT
01570 PRINT"CYC/H";TAB(18);"FAILURE RATE (%/1000 HRS.)"
01580 PRINT
01590 PRINTTAB(14);"L(8)";SPC(5);"L(SW) UPPER",SPC(5);"L(SW) LOWER"
01600 PRINT
01610 FORJ1=3TOS2STEP53

```

# SWITCHES

```

01620 IFJ1>1THEN1650
01630 LETJ=1
01640 GOTO1660
01650 LETJ=J1
01660 IFX3>2THEN1750
01670 IFX2=1THEN1710
01680 IFX2=2THEN1730
01690 PRINTJ,A(X4),A2*J,A3*J
01700 GOTO1820
01710 PRINTJ,A(X4),A2*J,"NA"
01720 GOTO1820
01730 PRINTJ,A(X4),"NA",A3*J
01740 GOTO1820
01750 IFX2=1THEN1790
01760 IFX2=2THEN1810
01770 PRINTJ,"NA",(.04+A(X4)*N)*X(Y5)*J*H1, (.04+A(X4)*N)*X(Y5)*J*H2
01780 GOTO1820
01790 PRINTJ,"NA",(.04+A(X4)*N)*X(Y5)*J*H1,"NA"
01800 GOTO1820
01810 PRINTJ,"NA","NA",(.04+A(X4)*N)*X(Y5)*J*H2
01820 LETS6=S6+1
01830 IFS6<60THEN1850
01840 GOSUB2110
01850 NEXTJ1
01860 FORI=S6TO60
01870 PRINT
01880 NEXT I
01890 GOSUB2110
01900 PRINT"ANOTHER ANALYSIS -- YES OR NO"
01910 INPUTUS
01920 IFUS="NO"THEN2200
01930 PRINT
01940 PRINT"SAME RELIABILITY GRADE -- YES OR NO"
01950 INPUTUS(2)
01960 PRINT
01970 PRINT"SAME ENVIRONMENT -- YES OR NO"
01980 INPUTUS
01990 IFUS="NO"THEN0610
02000 PRINT"D(X1)="D(X1),"A(X4)="A(X4),"H1="H1,"H2="H2,"X(Y5)="X(Y5)
02010 PRINT"N="N
02020 GOTO2200
02030 DATATOGGLE OR PUSHBUTTON,BASIC SENSITIVE,ACTUATION ASSEMBLY
02040 DATAROTARY SWITCH WAFERS
02050 DATASNAP ACTION, NON-SNAP ACTION, ACTUATION DIFFERENTIAL >.002 IN.
02060 DATAACTUATION DIFFERENTIAL <.002IN., CERAMIC RF WAFER
02070 DATA MEDIUM POWER WAFERS
02080 DATA.005,.01,1,.01,.4,6,1.5,.005,.07,36,2,.01,.07,49,8
02090 DATA.001,.02,8,8,.001,.02,24,10,55
02100 DATA1,1.5,1.75,2,2.5,3,4,25,5.5,8
02110 LETS6=6
02120 FORI=1TO6
02130 PRINT
02140 NEXTI
02150 PRINT"*****"

```

# SWITCHES

```
00160 FORI=1T06  
00170 PRINT  
00180 NEXTI  
00190 RETURN  
00200 END  
00615 IFUS<>"YES"THEN00200
```

# SEMICONDUCTORS

```

00010 DIMA(10),B(10),C(10),D(10),E(10),F(10)
00020 DIM K(10),L(10),N(10),ZS(10),VS(10)
00030 DIMM(10),VS(10),S(10),G(4)
00040 QOSUB3200
00050 PRINTTAB(13);"SEMICONDUCTOR FAILURE RATE"
00060 LETN(10)=100
00070 PRINT
00080 PRINT
00090 PRINT"INSTRUCTIONS -- YES OR NO?"
00100 INPUT ZS
00110 IFZS<>"YES"THEN00640
00120 PRINT
00130 PRINT"THIS PROGRAM CALCULATES THE BASE AND CATASTROPHIC FAILURE"
00140 PRINT"RATE OF SEMICONDUCTORS IN ACCORDANCE WITH THE RADC"
00150 PRINT"RELIABILITY NOTEBOOK, VOL 11, SEPT., 1967."
00160 PRINT
00170 PRINTTAB(13);"INPUT REQUIREMENTS AND CODES"
00180 PRINT
00190 PRINT1)TAB(11);"ENVIRONMENT"
00200 PRINT
00210 PRINTTAB(11);"(1) LABORATORY      (2) SATELLITE ORBIT"
00220 PRINTTAB(11);"(3) GROUND FIXED      (4) GROUND PORTABLE"
00230 PRINTTAB(11);"(5) AIRBORNE INHABITED  (6) GROUND MOBILE"
00240 PRINTTAB(11);"(7) AIRBORNE UNINHABITED (8) SATELLITE LAB"
00250 PRINTTAB(11);"(9) MISSILE"
00260 PRINT
00270 PRINT"2)TAB(11);"MODEL"
00280 PRINT
00290 PRINTTAB(11);"(1) GENERAL TRANSISTOR, (2) FIELD EFFECT, (3) UNIJON
00300 PRINTTAB(11);"(4) DIODES AND RECTIFIERS, (5) ZENER DIODES,"
00310 PRINTTAB(11);"(6) SILICON CONTROLLED RECTIFIERS (SCR)"
00320 PRINTTAB(11);"(7) MICROWAVE DETECTORS AND MIXERS, AND"
00330 PRINTTAB(11);"(8) VARACTOR AND STEP RECOVERY DIODES"
00340 PRINT
00350 PRINT"3)TAB(11);"PART TYPE"
00360 PRINT
00370 PRINT"4)TAB(11);"GRADE OF RELIABILITY -- (1) UPPER OR (2) LOWER"
00380 PRINT
00390 PRINT"5)TAB(11);"APPLICATION"
00400 PRINT
00410 PRINT"6)TAB(11);"CURRENT OR POWER RATING (WATTS/AMPS)"
00420 PRINT
00430 PRINT"7)TAB(11);"VOLTAGE STRESS (PERCENT)"
00440 PRINT
00450 PRINT"8)TAB(11);"MAX, MIN AND INCREMENT OF STRESS RATIO"
00460 PRINT
00470 PRINT"9)TAB(11);"MAX, MIN AND INCREMENT OF OPER TEMPERATURE"
00480 PRINT
00490 PRINT"NOTES"
00500 PRINT
00510 PRINT"PART TYPE, APPLICATION, AND CURRENT OR POWER RATING ARE CODE
00520 PRINT"HOVEVER, THEY ARE NOT THE SAME FOR EACH MODEL, THUS THEY ARE
00530 PRINT"INCLUDED HERE-IN. THESE CODES SHOULD NOT GIVE THE USER ANY"
00540 PRINT"DIFFICULTY SINCE THEY ARE STRAIGHT FORWARD"

```



# SEMI CONDUCTORS

```

00550 PRINT
00560 PRINT"IF ONLY ONE VALUE IS TO BE ENTERED FOR A STRESS, INPUT THAT"
00570 PRINT"VALUE FOR MAX, MIN AND INCREMENT."
00580 PRINT
00590 PRINT"RUN --- YES OR NO?"
00600 INPUT Z
00610 IF Z<>"N"GO TO 0630
00620 GO TO 3280
00630 GOSUB 3170
00640 IF Z$(10)="YES"THEN 0690
00650 PRINT
00660 PRINT"ENVIRONMENT = (1) LAB, (2) SO, (3) GP, (4) GP, (5) AI,"
00670 PRINT"(6) GM, (7) AU, (8) SL OR (9) M -- INPUT 1,2,... OR 9"
00680 INPUT Y
00690 PRINT
00700 IF Y$(10)="YES"THEN 0730
00710 PRINT"SEMC. MODEL =:"
00720 PRINT
00730 FOR I=1 TO 8
00740 READ Z$(I),K(I),L(I),M(I)
00750 IF Y$(10)="YES"THEN 0770
00760 PRINT TAB(5),I,Z$(I)
00770 NEXT I
00780 IF Y$(10)="YES"THEN 0820
00790 PRINT
00800 PRINT"INPUT 1,2,...,OR 5"
00810 INPUT X1
00820 IF X1=1 THEN 0860
00830 PRINT
00840 IF Y$(8)="YES"THEN 0860
00850 PRINT"PART TYPE =:"
00860 FOR I=1 TO 8
00870 IF X1=8 THEN 0970
00880 FOR J=1 TO K(I)
00890 IF I<>X1 THEN 0950
00900 READ W$(J),A(J),B(J),C(J),D(J),E(J),F(J)
00910 IF X1=1 THEN 0960
00920 IF Y$(8)="YES"THEN 0940
00930 PRINT TAB(5),J,W$(J)
00940 GOTO 0960
00950 READ W$(10),A1,A1,A1,A1,A1,A1
00960 NEXT J
00970 NEXT I
00980 IF X1<>1 THEN 1010
00990 LET X2=1
01000 GOTO 1030
01010 PRINT"INPUT 1,2,..."
01020 INPUT X2
01030 IF Y$(9)="YES"THEN 1090
01040 PRINT
01050 PRINT"GRADE OF RELIABILITY = (1) UPPER OR (2) LOWER -- INPUT 1 OR 2"
01060 INPUT X4
01070 PRINT
01080 PRINT
01090 FOR I=1 TO 8

```

# SEMICONDUCATORS

```

01100 IFX1<>1 THEN1190
01110 FORJ=1TO9
01120 LETN(J)=100
01130 IFJ<>Y5 THEN1160
01140 READG(1),G(2),G(3),G(4)
01150 GOTO1170
01160 READG8,G7,G9,G6
01170 NEXTJ
01180 GOTO1280
01190 FORJ=1TO9
01200 READG8,G7,G9,G6
01210 NEXT J
01220 NEXTI
01230 PRINT
01240 IFX4=0 THEN1280
01250 LETG1=G(1)
01260 LETG2=G(3)
01270 GOTO1300
01280 LETG1=G(2)
01290 LET G2=G(4)
01300 IFL(X1)=0 THEN1320
01310 PRINT"APPLICATION : "
01320 FORI=1TO8
01330 IFL(I)=0 THEN1410
01340 FORJ=1TOI(1)
01350 IFI<>X1 THEN1390
01360 READVJ(J),N(J)
01370 PRINTJ, TAB(5),VJ(J)
01380 GOTO1400
01390 READVJ(7),N(7)
01400 NEXTJ
01410 NEXTI
01420 LETJ1=J1+1
01430 IFJ1=1 THEN1450
01440 RETURN
01450 IFL(X1)=0 THEN1500
01460 PRINT"INPUT 1,2,...,")
01470 INPUTI
01480 LETES(8)=VJ(1)
01490 LETN(8)=N(1)
01500 FORI=1TO8
01510 LETL(I)=N(I)
01520 LETS(I)=1
01530 NEXTI
01540 IFL(X1)=0 THEN1560
01550 PRINT"CURRENT OR POWER RATING =:"
01560 GOSUB1380
01570 IFL(X1)=0 THEN1650
01580 PRINT"INPUT1,2,3,...")
01590 INPUTI
01600 LETS(10)=VJ(1)
01610 LETN(10)=N(1)
01620 IFN(8)<>100 THEN1650
01630 LETN(8)=1

```

# SEMICONDUCTORS

```

01640 LET Z5(8)="NA"
01650 IFN(10)<>100THEN1680
01660 LETN(10)=1
01670 LETZ5(10)="NA"
01680 IFX1=1THEN1710
01690 IFX1=3THEN1710
01700 GOTO1730
01710 PRINT"VOLTAGE STRESS (PERCENT)="
01720 INPUTI
01730 FORI=0TO100STEP10
01740 IFI>1 THEN1790
01750 IFJ1=0THEN1790
01760 READS(1),S(4)
01770 LETJ1=0
01780 GOTO1800
01790 READ S8,S9
01800 NEXTI
01810 LETN(9)=1
01820 IFX1=2THEN2000
01830 PRINT
01840 PRINT"COMPLEXITY ="
01850 FORI=1TO7
01860 READ VS(1),N(1)
01870 IFX1=2THEN1890
01880 PRINTTAB(5)IISPC(2)VS(1)
01890 NEXTI
01900 IFX1=1THEN1950
01910 FORI=1TO5
01920 READVS(1),N(1)
01930 PRINTTAB(5)IISPC(2)VS(1)
01940 NEXT I
01950 PRINT
01960 PRINT"INPUT 1,2,3,...."
01970 INPUTF1
01980 LETZ5(9)=VS(F1)
01990 LET N(9)=N(F1)
02000 PRINT
02010 PRINT"MAX, MIN AND INCREMENT OF STRESS RATIO ="
02020 INPUT O1,O2,O3
02030 PRINT
02040 PRINT"MAX, MIN AND INCREMENT OF OPERATING TEMPERATURE (DEGREES C)="
02050 INPUT T1,T2,T3
02060 GOSUB3170
02070 PRINTTAB(13)Z5(X1)SPC(2)"SEMICONDUCTOR"
02080 PRINT
02090 PRINT
02100 IFK(X1)=1THEN2120
02110 PRINT"PART TYPE ="VS(X2)SPC(5)
02120 IFN(8)=100THEN2140
02130 PRINT"APPLICATION ="Z5(5)
02140 PRINT
02150 IFL(X1)=0THEN2150
02160 PRINT"CURRENT OR POWER RATING (WATTS OR AMPS)="Z5(10)
02170 PRINT

```

# SEMICONDUCTORS

```

02180 IF I1=0 THEN 2210
02190 PRINT
02200 PRINT "VOLTAGE STRESS (Z) =" ; I1 ; SPC(4) ;
02210 IF X1>2 THEN 2230
02220 PRINT "COMPLEXITY =" ; Z ; S(9)
02230 PRINT
02240 PRINT "RELIABILITY GRADE CODE =" ; X4 ; SPC(4) ; "ENVIRONMENT CODE =" ; YS
02250 PRINT
02260 FOR O=02 TO 01 STEP 03
02270 PRINT "STRESS RATIO =" ; O
02280 PRINT
02290 PRINT TAB(17) ; "FAILURE RATE (Z/1000 HRS)"
02300 PRINT
02310 PRINT "TEMP", "L(B)", "L(SEM.)"
02320 PRINT
02330 PRINT
02340 FOR T=T2 TO T1 STEP T3
02350 LET C9=T+273
02360 IF B(X2)<0 THEN 2390
02370 LET K4=EXP(((C9+F(X2)*O)/C(X2))*B(X2))
02380 GO TO 2400
02390 LET K4=A(X2)*EXP((1/((C9+F(X2)*O)/C(X2))*(-B(X2))))
02400 LET K4=K4*EXP(((C9+F(X2)*O)/D(X2))*E(X2))
02410 PRINTT, K4, K4*G1*N(8)*N(9)*N(10)*S(X1)+G2
02420 NEXT T
02430 PRINT
02440 NEXT O
02450 LET I1=0
02460 RESTORE
02470 RESTORE $
02480 GO SUB 3200
02490 PRINT "ANOTHER ANALYSIS -- YES OR NO"
02500 INPUT Z$(10)
02510 IF Z$(10)="NO" THEN 3250
02520 PRINT "SAME ENVIRONMENT -- YES OR NO" ;
02530 INPUT Z$(10)
02540 PRINT "SAME MODEL" ;
02550 INPUT V$(10)
02560 PRINT "SAME RELIABILITY GRADE -- YES OR NO" ;
02570 INPUT V$(9)
02580 GO TO 0630
02590 DATA GENERAL TRANSISTOR, 4, 6, 6, FIELD EFFECT, 1, 6, 0, UNIJUNCTION, 1, 0, 0
02600 DATA DIODES AND RECTIFIERS, 2, 6, 6, ZENER DIODES, 1, 2, 6
02610 DATA SILICON CONTROLLED RECTIFIERS (SCR), 1, 0, 4
02620 DATA MICROWAVE DETECTORS AND MIXERS, 4, 0, 0
02630 DATA VARACTOR AND STEP RECOVERY DIODES, 1, 0, 6
02640 DATA SI-NPN, .027, -1, -1052, 448, 10.5, 150, 31-PNP, .085, -1, -1324, 338, 140
02650 DATA GE-PNP, 4.6, -1, -2142, 373, 20.8, 75, GE-NPN, 8.5, -1, -2221, 373, 19, 75
02660 DATA FET AND IGFET, .075, -1, -1168, 448, 13.8, 150, UNIJ TRAN, 7.81, -1, -10
02670 DATA SILICON, .13, -1, -2138, 448, 17.7, 150, GERMANIUM, 15.7, -1, 3568, 373, 8
02680 DATA VOLT REG., .274, -1, -2242, 448, 10.7, 175, ALL SCR, .286, -1, -2050, 4230
02690 DATA DECT 70-MAX, .265, -1, -477, 343, 15.6, 45, DECT 150-MAX, .055, -1, -390
02700 DATA MIXER 70-MAX, .445, -1, 447, 343, 15.6, 45
02710 DATA MIXER 150-MAX, .075, -1, -394, 423, 15.6, 125

```

# SEMICONDUCTORS

```

02720 DATA VARACTOR AND STEP RECOVERY DIODES,.37,-1,-1162,448,13.8,156
02730 DATA1,10,0,0,5,50,.0005,.005,15,150,.001,.01,40,400,.004,.04
02740 DATA30,300,.004,.04,50,500,.005,.05,50,500,.005,.05,80,800,.02,.2
02750 DATA140,1400,.02,.2
02760 DATA1,20,0,0,10,200,.005,.1,30,600,.01,.2,80,1600,.02,.4,60,1200,.0
02770 DATA100,2000,.02,.4,100,2000,.02,.4,160,3200,.03,.6,280,5600,.05,1
02780 DATA1,20,0,0,5,100,.02,.4,15,300,.06,1,2,40,800,.15,3,30,300,.15,3
02790 DATA50,1000,.2,4,50,1000,.2,4,80,1600,.2,4,140,2800,.3,6
02800 DATA1,6,0,0,5,30,.0005,.005,15,90,.001,.01,40,240,.002,.02
02810 DATA30,180,.002,.02,50,300,.003,.03,50,300,.003,.03
02820 DATA70,420,.006,.06,120,720,.01,.1
02830 DATA1,10,0,0,5,50,.001,.01,15,150,.001,.01,40,400,.004,.04
02840 DATA30,300,.004,.04,50,500,.006,.06,50,500,.006,.06,70,700,.01,.1
02850 DATA 120,1200,.02,.2
02860 DATA1,10,0,0,5,50,.001,.02,20,200,.001,.02,40,400,.005,.1,30,300,.0
02870 DATA50,500,.005,.1,50,500,.005,.1,180,1000,.01,.2,150,1500,.02,.4
02880 DATA1,3,0,0,2,6,.02,.06,30,90,.02,.06,120,360,.8,2,4,100,300,.6,18
02890 DATA150,450,.9,2,7,150,450,.9,2,7,750,2250,4,5,15,1500,4500,9,25
02900 DATA1,5,0,0,5,25,.01,.05,15,75,.03,.15,40,200,.08,.4,30,150,.06,.3
02910 DATA50,250,.1,.5,50,250,.1,.5,80,400,.16,.8,120,600,.25,1,25
02920 DATA LINEAR(AC),1,LINEAR(DC),2,LOW NOISE(AUDIO),1,5,HIGH FREQUENCY
02930 DATA3,LOW NOISE(RF),4,LOGIC SWITCHING,.5
02940 DATA LINEAR(AC),1,LINEAR(DC),2,LOGIC SWITCH,.5,LOW NOISE AUDIO,1,5
02950 DATA HIGH FREQUENCY(RF),3,LOW NOISE(RF),4
02960 DATA SIGNAL (AUDIO),1,SIGNAL (IF AND RF),1,5,LOGIC SWITCHING,.3
02970 DATA POWER RECTIFIER,1,POWER RECT. (H.V. STACKS) VMAX >600,2
02980 DATA FORWARD REFERENCE,.3,VOLTAGE REGULATOR,1
02990 DATA VOLTAGE REFERENCE (TEMP. COMPENSATED),1
03000 DATA "0 TO 100 MW",1,">100 TO 500 MW",1,">.5 TO 1 W",1,">1 TO 5 W",1
03010 DATA ">5 TO 20 W",2,">20 W",2
03020 DATA "0 TO 100 MA",1,2,">100 TO 500 MA",1,">.5 TO 1 A",1,1
03030 DATA ">1 TO 3 W",1,5,">3 TO 10 W",2,">10 W",2,5
03040 DATA "0 TO 250 MW",1,2,">250 TO 500 MW",1,">500 TO 1 W",1,2
03050 DATA ">1 TO 5 W",1,5
03060 DATA ">5 TO 20 W",2,">20 W",3
03070 DATA "0 TO 500 MA",1,2,">.5 TO 1 A",1,"1 TO 10 A",1,5,"10 A",2
03080 DATA "0 TO 100 MW",1,3,">100 TO 500 MW",1,">.5 TO 1 W",1,5
03090 DATA ">1 TO 5 W",2,">5 TO 20 W",3,">20 W",4
03100 DATA 3,.7,.3,.7,.3,.7,.36,.7,.48,.7,.75,.7,1,.7,1,2,.75
03110 DATA 1.65,.8,2,25,.9,3,.1
03120 DATA "SINGLE TRANSISTOR",1,DUAL (UNMATCHED),.7,DUAL (MATCHED),1,2
03130 DATA "DARLINGTON",.8,"DUAL EMITTER",1,1,"MULTIPLE EMITTER",1,2
03140 DATA "COMPLEMENTARY PAIR",.7
03150 DATA "SINGLE DEVICE",1,"DUAL UNMATCHED",.7,"DUAL MATCHED",1,2
03160 DATA "DUAL COMPLEMENTARY",.7,"TETRODE",1,1
03170 FORI=1 TO 12
03180 PRINT
03190 NEXT I
03200 FORI=1 TO 6
03210 PRINT
03220 NEXT I
03230 PRINT "=====
03240 FORI=1 TO 6
03250 PRINT

```

SEMI CONDUCTORS

03265 NEXT 1  
03270 RETURN  
03280 END

# MICROCIRCUITS

```

00010 DIMZ$(10),B(20),A(20)
00020 PRINT TAB(15);"FAILURE RATE OF MICROCIRCUITS"
00030 PRINT
00040 PRINT
00050 PRINT"INSTRUCTIONS--YES OR NO";
00060 INPUTZ$
00070 PRINT
00080 IFZ$<>"YES"THEN0380
00090 PRINT
00100 PRINTTAB(17);"INPUT REQUIREMENTS"
00110 PRINT
00120 PRINT"1";TAB(11);"ENVIRONMENT"
00130 PRINT
00140 PRINTTAB(11);"(1) LABORATORY, (2) SATELLITE ORBIT, (3) GROUND FIXED
00150 PRINT TAB(11);"(4) GROUND PORTABLE, (5) GROUND MOBILE,"
00160 PRINTTAB(11);"(6) AIRBORNE INHABITED, (7) AIRBORNE UNINHABITED,"
00170 PRINTTAB(11);"(8) SATELLITE LAUNCH, (9) MISSILE"
00180 PRINT
00190 PRINT"2";TAB(11);"PART IDENTIFIER"
00200 PRINT
00210 PRINT"3";TAB(11);"NUMBER OF BASIC FUNCTIONS"
00220 PRINT
00230 PRINT"4";TAB(11);"OPEN VOLTAGE GAIN"
00240 PRINT
00250 PRINT"5";TAB(11);"NUMBER OF EXTRA OR SPECIAL INPUTS"
00260 PRINT
00270 PRINT"6";TAB(11);"NUMBER OF EXTRA OR SPECIAL OUTPUTS"
00280 PRINT
00290 PRINT"7";TAB(11);"TYPE OF PACKAGE"
00300 PRINT
00310 PRINT"8";TAB(11);"QUALITY GRADE"
00320 PRINT
00330 PRINT"9";TAB(11);"MAX, MIN AND INCREMENT OF JUNCTION TEMPERATURE"
00340 PRINT
00350 PRINT"DO YOU WISH TO RUN -- YES OR NO";
00360 INPUTZ$
00370 IFZ$="NO"THEN2710
00380 PRINT
00390 PRINT "ENVIRONMENT =? (1) LAB, (2) SO, (3) GF, (4) GP, (5) GM,"
00400 PRINT "(6) AI, (7) AU, (8) SL OR (9) MISSILE -- INPUT 1, 2, ...,9"
00410 INPUTY$
00420 PRINT
00430 PRINT"ANALYSIS FOR (1) DIGITAL OR (2) LINEAR MICROCIRCUITS - ";
00440 PRINT"INPUT 1 OR 2";
00450 INPUT A4
00460 PRINT
00470 PRINT"INPUT PART IDENTIFIER";
00480 INPUTZ$(9)
00490 LETZ$(1)="DIGITAL MICROCIRCUITS"
00500 LET Z$(2)="LINEAR MICROCIRCUITS"
00510 IFA4=1THEN0770
00520 PRINT
00530 PRINT "NUMBER OF BASIC FUNCTIONS = ";
00540 INPUT A1

```

# MICROCIRCUITS

```

00550 LET A1=A1+4
00560 PRINT
00570 PRINT"OPEN VOLTAGE GAIN = ";
00580 INPUT A(4)
00590 PRINT
00600 IFA(4)<=60 THEN 0620
00610 LET A1=A1+(A2-60)/10
00620 LET A1=A1+(A(4)-60)/10
00630 PRINT"NUMBER OF EXTRA OR SPECIAL INPUTS (SUCH AS NON-INVERTING)="
00640 INPUT A(1)
00650 LET A1=A1+2*A(1)
00660 PRINT
00670 PRINT"NUMBER OF EXTRA OR SPECIAL OUTPUTS (SUCH AS EMITTER FOLLOWER
00680 INPUT A(2)
00690 LET A1=A1+2*A(2)
00700 PRINT
00710 PRINT "NUMBER OF OTHER SPECIAL FEATURES (SUCH AS THRESHOLD LIMITING
00720 PRINT "OR EXTREME FREQ RES)="
00730 INPUT A(3)
00740 PRINT
00750 LET A1=A1+3*A(3)
00760 GOTO 1360
00770 PRINT
00780 PRINT "DO YOU KNOW THE VALUE OF THE COMPLEXITY FACTOR PI(C)"
00790 PRINT "YES OR NO";
00800 INPUT Z$ (3)
00810 IF Z$ (3)="YES" THEN 1330
00820 PRINT
00830 PRINT
00840 PRINT TAB(10); "COMPLEXITY FACTORS FOR DIGITAL MICROCIRCUITS"
00850 PRINT
00860 PRINT "COMPLEXITY"; TAB(17); "LOGIC"; TAB(47); "INPUT DESCRIPTION"
00870 PRINT "*****"
00880 PRINT "1"; TAB(13); "BASIC SINGLE GATE"; TAB(46); "UP TO 4 INPUTS"
00890 PRINT
00900 PRINT TAB(13); "SINGLE GATE"; TAB(46); "4 TO 8 INPUTS"
00910 PRINT TAB(13); "DUAL GATE"; TAB(46); "UP TO 4 INPUTS"
00920 PRINT TAB(13); "EXPANDER"; TAB(46); "UP TO 5 INPUTS"
00930 PRINT TAB(13); "DUAL INVERTER"; TAB(46); "ANY"
00940 PRINT "*****"
00950 PRINT
00960 PRINT "2"; TAB(13); "TRIPLE GATE"; TAB(46); "UP TO 4 INPUTS"
00970 PRINT TAB(13); "EXCLUSIVE OR GATE"; TAB(46); "UP TO 4 INPUTS"
00980 PRINT TAB(13); "TRIPLE NAND GATE"; TAB(46); "UP TO 3 INPUTS"
00990 PRINT TAB(13); "TRIPLE NAND/NOR GATE"; TAB(46); "UP TO 3 INPUTS"
01000 PRINT TAB(13); "NAND/NOR WITH EMITTER"
01010 PRINT TAB(13); "FOLLOWER"; TAB(46); "UP TO 6 INPUTS"
01020 PRINT TAB(13); "ADDER"; TAB(46); "ANY"
01030 PRINT
01040 PRINT TAB(13); "QUAD GATE"; TAB(46); "UP TO 4 INPUTS"
01050 PRINT TAB(13); "DUAL EXPANDER"; TAB(46); "UP TO 4 INPUTS"
01060 PRINT TAB(13); "DUAL NAND/NOR GATE"; TAB(46); "UP TO 5 INPUTS"
01070 PRINT TAB(13); "QUAD INVERTER DRIVER"; TAB(46); "ANY"
01080 PRINT TAB(13); "TRIPLE NAND/NOR WITH"

```



# MICROCIRCUITS

```

01090 PRINT TAB(13);"EMITTER FOLLOWER";TAB(46);"UP TO 4 INPUTS"
01100 PRINT TAB(13);"SIMPLE FLIP-FLOP";TAB(46);"2 INPUTS"
01110 PRINT"*****"
01120 PRINT
01130 PRINT
01140 PRINT "3";TAB(13);"JK FLIP-FLOP WITH"
01150 PRINT TAB(13);" PRESET AND/OR CLEAR";TAB(46);"ANY"
01160 PRINT TAB(13);"DUAL EXCLUSIVE-OR GATE";TAB(46);"UP TO 4 INPUTS"
01170 PRINT TAB(13);"ONE SHOT MULTIVIBRATOR"
01180 PRINT
01190 PRINT TAB(13);"JK/R-S FLIP-FLOP"
01200 PRINT TAB(13);"QUAD NAND/NOR";TAB(46);"ANY"
01210 PRINT"*****"
01220 PRINT
01230 PRINT
01240 PRINT"4";TAB(13);"DUAL SIMPLE FLIP-FLOP";TAB(46);"2 INPUTS"
01250 PRINT TAB(13);"RS FLIP-FLOP/COUNTER";TAB(46);"ANY"
01260 PRINT TAB(13);"RIPPLE COUNTERS";TAB(46);"ANY"
01270 PRINT
01280 PRINTTAB(13);"DUAL JK FLIP-FLOP WITH"
01290 PRINT TAB(13);" PRESET AND/OR CLEAR";TAB(46);"ANY"
01300 PRINT"*****"
01310 PRINT
01320 PRINT
01330 PRINT
01340 PRINT"COMPLEXITY FACTOR =";
01350 INPUT A1
01360 PRINT
01370 PRINT "TYPE OF PACKAGE ="
01380 PRINT
01390 PRINT "FLATPACK -- (1) GLASS, (2) ALUMINUM, (3) METAL"
01400 PRINT
01410 PRINT "OR"
01420 PRINT
01430 PRINT"TO-5 -- (4) GLAS FRIT, (5) EUTECTIC SOLDER"
01440 PRINT
01450 PRINT "INPUT 1, 2, 3, 4, OR 5"
01460 INPUT A5
01470 PRINT
01480 FOR I=1 TO 9
01490 READ B(I)
01500 NEXT I
01510 LET B1=B(A5)
01520 LET Z$(3)="OPTIMUM SCREENING"
01530 LET Z$(4)="UPPER GRADE"
01540 LET Z$(5)="AVERAGE GRADE"
01550 LET Z$(6)="LOWER GRADE"
01560 PRINT"QUALITY GRADE = (1) OPTIMUM SCREEN, (2) UPPER GRADE,"
01570 PRINT"(3) AVERAGE GRADE, (4) LOWER GRADE OR (5) EXPLANATION - INP
01580 INPUT A5
01590 IF A5<>5 THEN 1550
01600 PRINT
01610 PRINTTAB(15);"ADJUSTMENT FACTORS"
01620 PRINT

```

# MICRO CIRCUITS

```

01630 PRINT"PI(Q)"TAB(17);"QUALITY GRADE"
01640 PRINT"*****"
01650 PRINT
01660 PRINT1;TAB(13);"OPTIMUM SCREEN WHICH INCLUDES:"
01670 PRINT TAB(13);"A. VENDOR, LINE AND PRODUCT QUALIFICATION
01680 PRINT TAB(13);"B. LINE DISCIPLINE ON AN INTERFERENCE BASIS.
01690 PRINT TAB(13);"C. FAILURE FEEDBACK (TIGHT LOOP) WITH CONTINUOUS
01700 PRINT TAB(16);"CORRECTIVE ACTION SIMILAR TO MINUTEMAN PROCEDURES"
01710 PRINT TAB(13);"D. SCREENS AND BURN-IN
01720 PRINT TAB(13);"E. TRACEABILITY OF TEST DATA.
01730 PRINT
01740 PRINT2;TAB(13);"UPPER GRADE WHICH INCLUDES:"
01750 PRINT TAB(13);"A. SCREENS AND BURN-IN COMPARABLE TO RADE SPEC.
01760 PRINTTAB(16);"ON LIMIT TESTING (SAMPLE SUBJECT TO DESTRUCTIVE TEST
01770 PRINT TAB(16);"TO ESTABLISH ABSOLUTE LIMITS OF STRESSES WHICH DEVE
01780 PRINT TAB(16);"CAN WITHSTAND) TO IDENTIFY MAJOR FAILURE MODES AND"
01790 PRINT TAB(13);"B. FEEDBACK FROM SCREENING RESULTS ONLY
01800 PRINT
01810 PRINT 15;TAB(13);"AVERAGE GRADE WHICH INCLUDES:"
01820 PRINT TAB(13);"A. NORMAL PRODUCTION GRADE AND LOT ACCEPTANCE TEST
01830 PRINT TAB(16);"ON A SAMPLING BASIS."
01840 PRINT TAB(13);"B. NO 100% SCREENING BEYOND PROCEDURES FOR
01850 PRINT TAB(16);"ELECTRICAL PARAMETERS AND HERMETICITY."
01860 PRINT
01870 PRINT 30, TAB(13);"LOWER GRADE WHICH INCLUDES ROUTINE VENDOR PROC
01880 PRINT TAB(13);"WHICH ARE APPLIED TOALL PRODUCTION DEVICES ON A 10
01890 PRINT
01900 PRINT"*****"
01910 PRINT
01920 PRINT
01930 PRINT "QUALITY GRADE CODE = 1, 2, 3, OR 4";
01940 INPUT A5
01950 PRINT
01960 LET B2=B(A5+5)
01970 FORI=1TO9
01980 READ B(I)
01990 NEXT I
02000 LETB3=B2+B5;
02010 PRINT
02020 PRINT "WHAT IS THE MAX, MIN AND INCREMENT OF JUNCTION TEMPERATURE
02030 INPUT T1,T2,T3
02040 FOR I=1TO5
02050 PRINT
02060 NEXT I
02070 PRINT"-----"
02080 FOR I=1TO6
02090 PRINT
02100 NEXT I
02110 PRINT TAB(13);Z3(A4)
02120 PRINT
02130 PRINT
02140 PRINTZ3(9)
02150 PRINT
02160 IFA4=1THEN2210

```

# MICROCIRCUITS

```

02170 PRINT "NO. OF SPECIAL INPUTS =";A(1),"NO OF SPECIAL OUTPUTS =";A2
02180 PRINT
02190 PRINT"NO. OF SPECIAL FEATURES =";A(3),"OPEN VOLTAGE GAIN =";A(4
02200 PRINT
02210 PRINT TAB(15);"ENVIRONMENT CODE =";Y5
02220 PRINT
02230 PRINT "COMPLEXITY FACTOR =";A1,"QUALITY GRADE =";Z$(A5+2)
02240 PRINT
02250 PRINT
02260 LET N1=20
02270 PRINT"JUNCT TEMP";TAB(20);"BASE FAIL RATE";TAB(45);"FAIL RATE (%/S
02280 PRINT"-----",TAB(20);"-----";TAB(45);"-----"
02290 PRINT
02300 PRINT
02310 FOR T=T2TOT1STEPT3
02320 LET N1=N1+1
02330 PRINTT,TAB(23);.98*EXP(-2298/(T+273));
02340 PRINT TAB(47);A1*B1*B2*B3*EXP(-2298/(T+273))*98
02350 IFN1<60THEN2440
02360 FORI=1TO6
02370 LET N1=0
02380 PRINT
02390 NEXT I
02400 PRINT"-----"
02410 FOR I=1TO8
02420 PRINT
02430 NEXT I
02440 NEXTT
02450 IFN1=60 GOTO2530
02460 FOR I=N1TO66
02470 PRINT
02480 NEXT I
02490 PRINT"-----"
02510 DATA 2,5,2,2,2,1.5,1,2,15,30
02520 DATA 1,1.5,2,5,7,5,7,8,10
02530 FORI=1TO5
02540 PRINT
02550 NEXTI
02560 RESTOREI
02570 RESTORE
02580 PRINT"ANOTHER ANALYSIS -- YES OR NO"
02590 INPUTZ$(8)
02600 IFZ$(8)="NO"THEN 2710
02610 PRINT"SAME ENVIRONMENT -- YES OR NO";
02620 INPUT Z$(8)
02630 IFZ$(8)="NO"THEN0390
02640 PRINT
02650 PRINT"SAME PART TYPE -- YES OR NO";
02660 INPUTZ$(8)
02670 PRINT
02680 IFZ$(8)="NO"THEN0420
02690 PRINT
02700 GOTO 0470
02710 END

```

# PRINTED WIRING

```

00010 DIM US(10)
00020 DIMA(10),B(10),C(10),D(10)
00030 PRINT TAB(13);"FAILURE RATE OF PRINTED WIRING"
00040 PRINT
00050 PRINT
00060 FOR I=1 TO 5
00070 READA(I),B(I),C(I),D(I)
00080 NEXT I
00090 PRINT "ANALYSIS FOR -- (1) AVERAGE EXPERIENCE, (2) NORMAL UPPER LIM
00100 PRINT"(3) NORMAL LOWER LIMIT, (4) WORST EXPERIENCE OR"
00110 PRINT"(5) BEST EXPERIENCE -- INPUT 1,2,3,4, OR 5";
00120 INPUT N1
00130 LETUS(1)="AVERAGE EXPERIENCE"
00140 LETUS(2)="NORMAL UPPER LIMIT"
00150 LETUS(3)="NORMAL LOWER LIMIT"
00160 LETUS(4)="WORST EXPERIENCE"
00170 LETUS(5)="BEST EXPERIENCE"
00180 PRINT
00190 PRINT "NUMBER OF CONNECTIONS =";
00200 INPUT N3
00210 LETN2=LOG(N3)
00220 PRINT
00230 LETX1=LOG(A(N1))
00240 LETY1=LOG(B(N1))
00250 LETX2=LOG(C(N1))
00260 LETY2=LOG(D(N1))
00270 LETY=(Y2-Y1)*(N2-X1)/(X2-X1)+Y1
00280 GOSUB0480
00290 PRINT TAB(17);"PRINTED WIRING FAILURE RATE"
00300 PRINT
00310 PRINT
00320 PRINTTAB(13);US(N1)
00330 PRINT
00340 PRINT"NUMBER OF CONECTIONS =";N3
00350 PRINT
00360 PRINT TAB(5);"FAILURE RATE (1/1000 HRS) =";
00370 PRINT EXP(Y)
00380 GOSUB0480
00390 PRINT"ANOTHER ANALYSIS -- YES OR NO";
00400 INPUT US(8)
00410 IFUS(8)="NO" THEN0560
00420 PRINT
00430 PRINT
00440 GOTO0090
00450 DATA15,.011,700,.51,10,.011,100,.125,10,.0045,700,.29
00460 DATA10,.0497,70,.31,10,.0019,300,.0497
00470 GOTO0560
00480 FORI=1 TO 6
00490 PRINT
00500 NEXT I
00510 PRINT"*****"
00520 FORI=1 TO 6
00530 PRINT
00540 NEXT I

```

PRINTED WIRING

00550 RETURN  
00560 END

### SECTION III

#### PROGRAM INPUT - OUTPUT EXAMPLES

##### 1. INTRODUCTION

This section presents a number of computer run-offs of the computerized version, of the "RADC Reliability Notebook," Volume II, September 1967, as developed by RADC/EMWRR/OAFB/NY. These runs have been presented to illustrate the input, output and flexibility of the programs.

##### 2. PROGRAM INSTRUCTIONS

Each of the programs contain instructions which the user has option of listing on each computer run. The instructions are listings of the input data required to perform a run and notes which explain peculiarities of the programs. There should not be any difficulty in interpretation of the terms used therein, since the author has kept the terminology in close agreement with the Notebook. However, at this point the phrase, "Max, Min and Increment," should be discussed. This phrase is used in query of stresses. On such a query the user has the option of performing an analysis for one or more stress, in ascending or descending order, during a computer run.

Examples of stress query and inputs:

###### A. One stress value

Max, Min and increment of operating temperature? 70, 70, 70

###### B. Ascending values of stress

Max, Min and increment of stress ratio? 1, 0, .2

###### C. Descending values of stress

Max, Min and increment of operating temperature? 0, 150, - 25

A listing of the instructions is presented in Appendix I. The format of the listings are not the same because of computer storage.

### 3. DATA INPUTS

The programs are such that the values of the variables which are to be entered as data, are entered through the computer teletypewriter keyboard during the computer run. This is accomplished by typing the value of the variable and depressing the return key after the variable has been queried by the computer.

#### EXAMPLE

What is the resistance value (OHMS)? 5000 (return)\*\*\*

If more than one (1) variable is queried at a time, the user types the value of the variables separated by a comma and depresses the return key.

#### EXAMPLE

What is the multiple of longevity and value of  
PI(L)? 10, 3.6 (return)\*\*\*

\*\*\* (return) - depress return key on teletype keyboard

### 4. OUTPUT SYMBOLS AND CODES

The outputs of the computer programs have been kept as close as possible in agreement with the "RADC Reliability Notebook," Volume II, 1967. However, due to the limitations of the computer (keyboard, software, storage, etc.) many of the symbols and codes used in the notebook had to be coded or changed in the computer. The output codes are in agreement with the instruction codes.

### 5. EXAMPLES

The examples herein are the same as the ones in the notebook. Example 1 is presented to illustrate analyses of multiple stress conditions during one (1) computer run.

EXAMPLE I  
(POTENTIOMETERS)

01/28/70 13:29

FAILURE RATES FOR POTENTIOMETERS

DO YOU WISH INSTRUCTIONS --- YES OR NO?NO

ENVIRONMENT: (1) LAB, (2) SO, (3) GF, (4) GP,  
(5) AI, (6) G, (7) AU, (8) SL, (9) MIL -- INPUT 1,2,...9  
75

ANALYSIS FOR: (1) PRECISION, (2) SEMI-PRECISION,  
(3) LOW-PRECISION, (4) NON-WIREWOUND, (5) WIREWOUND,  
(6) ESTABLISHED RELIABILITY OR (7) HIGH POWER  
INPUT 1,2,..., OR 7?1

STRESS RATIO TO BE CALCULATED - YES OR NO?NO

GRADE OF RELIABILITY = (1) UPPER OR (2) LOWER -- INPUT 1 OR 2  
?1

IS FAILURE RATE FOR A MULTIPLE OF LONGEVITY TO BE CALCULATED  
INPUT YES OR NO  
?YES

MULTIPLE OF LONGEVITY AND  $P(L)$ ?73.1.45

APPLIED VOLTAGE?45

RATED VOLTAGE?250

RESISTANCE (OHMS)?1500

NUMBER OF TAPS?3

MAX, MIN AND INCREMENT OF STRESS RATIO? .71, .71, 1

MAX, MIN AND INCREMENT OF OPER TEMPERATURE - DEG C?50, 50, 30

CONSTRUCTION= 1, 2, 3, 4, 5, OR 6?2



PRECISION POTENTIOMETERS

RESISTANCE = 1500

ENVIRONMENT CODE = 5

GRADE OF RELIABILITY = UPPER

MULTIPLE OF LONGEVITY = 3

PI(L) = 1.45

STRESS RATIO = 0.71

TEMPERATURE

FAILURE RATE (Z/1000 HRS.)

L(B)

L(P)

L(PL)

50

2.24420E-02

0.493649

0.715791

ANOTHER ANALYSIS -- YES OR NO?YES

SAME ENVIRONMENTS -- YES OR NO?YES

SAME STRESS CONDITIONS -- YES OR NO?YES

SAME RESISTOR TYPE - YES OR NO?N\YES

STRESS RATIO TO BE CALCULATED - YES OR NO?NO

GRADE OF RELIABILITY = (1) UPPER OR (2) LOWER -- INPUT 1 OR 2  
?2

IS FAILURE RATE FOR A MULTIPLE OF LONGEVITY TO BE CALCULATED  
INPUT YES OR NO  
?YES

MULTIPLE OF LONGEVITY AND PI(L)=?6,2.64

APPLIED VOLTAGE?45

RATED VOLTAGE?250

RESISTANCE (OHMS)?1500

NUMBER OF TAPS?3

CONSTRUCTION=1,2,3,4,5,OR 6?2

---

#### PRECISION POTENTIOMETERS

RESISTANCE = 1500

ENVIRONMENT CODE = 5

GRADE OF RELIABILITY =LOWER

MULTIPLE OF LONGEVITY = 6

PI(L)= 2.64

STRESS RATIO = 0.71

TEMPERATURE

FAILURE RATE (%/1000 HRS.)

L(B)

L(P)

L(PL)

50

2.24420E-08

2.46825

6.51617

# EXAMPLE 11

## (SEMICONDUCTORS) SEMICONDUCTOR FAILURE RATE

INSTRUCTIONS -- YES OR NO?NO

ENVIRONMENT = (1) LAB, (2) SO, (3) GF, (4) GP, (5) AI,  
(6) GM, (7) AU, (8) SL OR (9) M -- INPUT 1,2,... OR 9?3

SEMC. MODEL =:

- |   |                                     |
|---|-------------------------------------|
| 1 | GENERAL TRANSISTOR                  |
| 2 | FIELD EFFECT                        |
| 3 | UNIUNCTION                          |
| 4 | DIODES AND RECTIFIERS               |
| 5 | ZENER DIODES                        |
| 6 | SILICON CONTROLLED RECTIFIERS (SCR) |
| 7 | MICROWAVE DETECTORS AND MIXERS      |
| 8 | VARACTOR AND STEP RECOVERY DIODES   |

INPUT 1,2,.....OR8?1

PART TYPE =:

- |   |        |
|---|--------|
| 1 | SI-NPN |
| 2 | SI-PNP |
| 3 | GE-PNP |
| 4 | GE-NPN |

INPUT 1,2,...?1

GRADE OF RELIABILITY = (1) UPPER OR (2) LOWER -- INPUT 1 OR 2?1

APPLICATION :

- |   |                    |
|---|--------------------|
| 1 | LINEAR(AC)         |
| 2 | LINEAR(DC)         |
| 3 | LOW NOISE(AUDIO)   |
| 4 | HIGH FREQUENCY(RF) |
| 5 | LOW NOISE(RF)      |
| 6 | LOGIC SWITCHING    |

INPUT 1,2,.... ?1

CURRENT OR POWER RATING =:

- |   |               |
|---|---------------|
| 1 | 0 TO 100 MW   |
| 2 | 100 TO 500 MW |
| 3 | .5 TO 1.      |
| 4 | 1. TO 5       |
| 5 | 5. TO 20      |
| 6 | 20            |

INPUT 1,2,3,...?2

VOLTAGE STRESS (PERCENT)=760

COMPLEXITY =

- |   |                    |
|---|--------------------|
| 1 | SINGLE TRANSISTOR  |
| 2 | DUAL (UNMATCHED)   |
| 3 | DUAL (MATCHED)     |
| 4 | DARLINGTON         |
| 5 | DUAL EMITTER       |
| 6 | MULTIPLE EMITTER   |
| 7 | COMPLEMENTARY PAIR |

INPUT 1,2,3,....?1

MAX, MIN AND INCREMENT OF STRESS RATIO =7.4,.4,.4

MAX, MIN AND INCREMENT OF OPERATING TEMPERATURE (DEGREES C)=  
730,30,30

GENERAL TRANSISTOR SEMICONDUCTOR

PART TYPE =SI-NPN APPLICATION =LINEAR(AC)

CURRENT OR POWER RATING (WATTS OR AMPS)=100 TO500 MW

VOLTAGE STRESS (%) = 60 COMPLEXITY =SINGLE TRANSISTOR

RELIABILITY GRADE CODE= 1 ENVIRONMENT CODE= 3

STRESS RATIO= 0.4

FAILURE RATE (%/1000 HRS)

TEMP	L(B)	L(SEM.)
------	------	---------

30	1.66124E-03	2.59186E-02
----	-------------	-------------

=====

ANOTHER ANALYSIS -- YES OR NO

?YES

SAME ENVIRONMENT -- YES OR NO?YES

SAME MODEL?YES

SAME RELIABILITY GRADE -- YES OR NO?NO

PART TYPE =:

1	SI-NPN
2	SI-PNP
3	GE-PNP
4	GE-NPN

INPUT 1,2,...?1

GRADE OF RELIABILITY = (1) UPPER OR (2) LOWER -- INPUT 1 OR 2?2

APPLICATION :

1	LINEAR(AC)
2	LINEAR(DC)
3	LOW NOISE(AUDIO)
4	HIGH FREQUENCY(RF)
5	LOW NOISE(RF)
6	LOGIC SWITCHING

INPUT 1,2,..., ?1

CURRENT OR POWER RATING =:

1	0 TO 100 MW
2	100 TO 500 MW
3	.5 TO 1.
4	1. TO 5
5	5. TO 20
6	20

INPUT 1,2,3,...?2

VOLTAGE STRESS (PERCENT)=?60

COMPLEXITY =

1	SINGLE TRANSISTOR
2	DUAL (UNMATCHED)
3	DUAL (MATCHED)
4	DARLINGTON
5	DUAL EMITTER
6	MULTIPLE EMITTER
7	COMPLEMENTARY PAIR

INPUT 1,2,3,...?1

MAX. MIN AND INCREMENT OF STRESS RATIO =?4,.4,.4

MAX. MIN AND INCREMENT OF OPERATING TEMPERATURE (DEGREES C)=  
730,30,30

GENERAL TRANSISTOR SEMICONDUCTOR

PART TYPE =SI-NPN APPLICATION =LINEAR(AC)

CURRENT OR POWER RATING (WATTS OR AMPS)=100 TO500 MW

VOLTAGE STRESS (%) = 60 COMPLEXITY =SINGLE TRANSISTOR

RELIABILITY GRADE CODE= 2 ENVIRONMENT CODE= 3

STRESS RATIO= 0.4

FAILURE RATE (%/1000 HRS)

TEMP	L(B)	L(SEM.)
30	1.66184E-03	0.259186

ANOTHER ANALYSIS -- YES OR NO  
?YES  
SAME ENVIRONMENT -- YES OR NO?NO  
SAME MODEL?NO  
SAME RELIABILITY GRADE -- YES OR NO?YES

ENVIRONMENT = (1) LAB, (2) SO, (3) GF, (4) GP, (5) AI,  
(6) GM, (7) AU, (8) SL OR (9) M -- INPUT: 1,2,.. OR 975

SEMC. MODEL =:

1	GENERAL TRANSISTOR
2	FIELD EFFECT
3	UNIUNCTION
4	DIODES AND RECTIFIERS
5	ZENER DIODES
6	SILICON CONTROLLED RECTIFIERS (SCR)
7	MICROWAVE DETECTORS AND MIXERS
8	VARACTOR AND STEP RECOVERY DIODES

INPUT 1,2,.....,OR872

APPLICATION :

1	LINEAR(AC)
2	LINEAR(DC)
3	LOGIC SWITCH
4	LOW NOISE AUDIO
5	HIGH FREQUENCY(RF)
6	LOW NOISE(RF)

INPUT 1,2,....., 76

COMPLEXITY =

1	SINGLE DEVICE
2	DUAL UNMATCHED
3	DUAL MATCHED
4	DUAL COMPLEMENTARY
5	TETRODE

INPUT 1,2,3,.....?1

MAX, MIN AND INCREMENT OF STRESS RATIO =7.4..4.1

MAX, MIN AND INCREMENT OF OPERATING TEMPERATURE (DEGREES C)=  
760,60,60

FIELD EFFECT SEMICONDUCTOR

APPLICATION =LOW NOISE(RF)

COMPLEXITY =SINGLE DEVICE

RELIABILITY GRADE CODE= 2

ENVIRONMENT CODE= 5

STRESS RATIO= 0.4

FAILURE RATE (Z/1000 HRS)

TEMP

L(B)

L(SEM.)

60

4.59421E-03

22.3522

=====

ANOTHER ANALYSIS -- YES OR NO

YES

SAME ENVIRONMENT -- YES OR NO

NO

SAME RELIABILITY GRADE -- YES OR NO

YES



ENVIRONMENT = (1) LAB, (2) SO, (3) GF, (4) GP, (5) AI,  
(6) GM, (7) AU, (8) SL OR (9) M -- INPUT 1,2... OR 9?6

SEMC. MODEL =:

1	GENERAL TRANSISTOR
2	FIELD EFFECT
3	UNIUNCTION
4	DIODES AND RECTIFIERS
5	ZENER DIODES
6	SILICON CONTROLLED RECTIFIERS (SCR)
7	MICROWAVE DETECTORS AND MIXERS
8	VARACTOR AND STEP RECOVERY DIODES

INPUT 1,2,....,OR8?4

PART TYPE =:

1	SILICON
2	GERMANIUM

INPUT 1,2,....?1

GRADE OF RELIABILITY = (1) UPPER OR (2) LOWER -- INPUT 1 OR 2?2

APPLICATION :

1	SIGNAL (AUDIO)
2	SIGNAL (IF AND RF)
3	LOGIC SWITCHING
4	POWER RECTIFIER
5	POWER RECT. (H.V. STACKS) VMAX >600
6	FORWARD REFERENCE

INPUT 1,2,...., ?3

CURRENT OR POWER RATING =:

1	0 TO 100 MA
2	100 TO 500 MA
3	.5 TO 1.
4	1 TO 3
5	3 TO 10
6	10

INPUT 1,2,3,....?1

MAX, MIN AND INCREMENT OF STRESS RATIO =7.4,.4,.4

MAX, MIN AND INCREMENT OF OPERATING TEMPERATURE (DEGREES C)=  
730,30,30

DIODES AND RECTIFIERS SEMICONDUCTOR

PART TYPE =SILICON APPLICATION =LOGIC SWITCHING

CURRENT OR POWER RATING (WATTS OR AMPS)=0 TO 100 MA

RELIABILITY GRADE CODE= 2

ENVIRONMENT CODE= 6

STRESS RATIO= 0.4

FAILURE RATE (%/1000 HRS)

TEMP

L(B)

L(SEM.)

30

3.68567E-04

5.78636E-02

=====

ANOTHER ANALYSIS -- YES OR NO  
?NO

EXAMPLE III  
(MICROCIRCUITS)

01/28/70

15:04

FAILURE RATE OF MICROCIRCUITS

INSTRUCTIONS--YES OR NOTNO

ENVIRONMENT =? (1) LAB, (2) SO, (3) GF, (4) GP, (5) GM,  
(6) AI, (7) AU, (8) SL OR (9) MISSILE -- INPUT 1, 2, ..., 9  
? 6

ANALYSIS FOR (1) DIGITAL OR (2) LINEAR MICROCIRCUITS - INPUT 1 OR 2? 2

INPUT PART IDENTIFIER OPERATIONAL AMPLIFIER

NUMBER OF BASIC FUNCTIONS = ? 1

OPEN VOLTAGE GAIN = ? 60

NUMBER OF EXTRA OR SPECIAL INPUTS (SUCH AS NON-INVERTING) =  
? 1

NUMBER OF EXTRA OR SPECIAL OUTPUTS (SUCH AS EMITTER FOLLOWER) =  
? 1

NUMBER OF OTHER SPECIAL FEATURES (SUCH AS THRESHOLD LIMITING  
OR EXTREME FREQ RES) = ? 0

TYPE OF PACKAGE =

FLATPACK -- (1) GLASS, (2) ALUMINUM, (3) METAL

OR

TO-8 -- (4) GLAS PRIT, (5) EUTECTIC SOLDER

INPUT 1, 2, 3, 4 OR 5  
? 1

QUALITY GRADE = (1) OPTIMUM SCREEN, (2) UPPER GRADE,

(3) AVERAGE GRADE, (4) LOWER GRADE OR (5) EXPLANATION - INPUT 1 2, 3, 4 3  
? 1

WHAT IS THE MAX, MIN AND INCREMENT OF JUNCTION TEMPERATURE - DEG C  
? 75, 75, 75

LINEAR MICROCIRCUITS

OPERATIONAL AMPLIFIER

NO. OF SPECIAL INPUTS = 1

NO OF SPECIAL OUTPUTS = 1

NO. OF SPECIAL FEATURES = 0

OPEN VOLTAGE GAIN = 60

ENVIRONMENT CODE = 6

COMPLEXITY FACTOR = 8

QUALITY GRADE = OPTIMUM SCREENING

JUNCT TEMP

BASE FAIL RATE

FAIL RATE (%/1000 HRS)

75

1.32857E-03

0.132857

ANOTHER ANALYSIS -- YES OR NO

?YES

SAME ENVIRONMENT -- YES OR NO?NO

ENVIRONMENT =? (1) LAB, (2) SO, (3) GF, (4) GP, (5) GM,  
(6) AI, (7) AU, (8) SL OR (9) MISSILE -- INPUT 1, 2,...,9

?3

ANALYSIS FOR (1) DIGITAL OR (2) LINEAR MICROCIRCUITS - INPUT 1 OR 2?1

INPUT PART IDENTIFIER?JK FLIP-FLOP

DO YOU KNOW THE VALUE OF THE COMPLEXITY FACTOR PI(C)

YES OR NO?YES

COMPLEXITY FACTOR =?3

TYPE OF PACKAGE =

FLATPACK -- (1) GLASS, (2) ALUMINUM, (3) METAL

OR

TO-5 -- (4) GLAS FRIT, (5) EUTECTIC SOLDER

INPUT 1, 2, 3, 4, OR 5

?4

QUALITY GRADE = (1) OPTIMUM SCREEN, (2) UPPER GRADE,

(3) AVERAGE GRADE, (4) LOWER GRADE OR (5) EXPLANATION - INPUT 1 2,3, 4 5  
?3,\

WHAT IS THE MAX, MIN AND INCREMENT OF JUNCTION TEMPERATURE - DEG C

?110,110,110

DIGITAL MICROCIRCUITS

JK FLIP-FLOP

ENVIRONMENT CODE = 3

COMPLEXITY FACTOR = 3

QUALITY GRADE = AVERAGE GRADE

JUNCT TEMP  
-----

BASE FAIL RATE  
-----

FAIL RATE (1/1000 HRS)  
-----

110

2.42918E-03

0.437252

ANOTHER ANALYSIS -- YES OR NO

?YES

SAME ENVIRONMENT -- YES OR NO?YES

SAME PART TYPE -- YES OR NO?YES

INPUT PART IDENTIFIER?JKK\ FLIP-FLOP

DO YOU KNOW THE VALUE OF THE COMPLEXITY FACTOR PI(C)  
YES OR NO?YES

COMPLEXITY FACTOR =?3

TYPE OF PACKAGE =

FLATPACK -- (1) GLASS, (2) ALUMINUM, (3) METAL

OR

TO-8 -- (4) GLAS FRIT, (5) EUTECTIC SOLDER

INPUT 1, 2, 3, 4, OR 5

?4

QUALITY GRADE = (1) OPTIMUM SCREEN, (2) UPPER GRADE,

(3) AVERAGE GRADE, (4) LOWER GRADE OR (5) EXPLANATION - INPUT 1 2,3, 4 &  
?3

WHAT IS THE MAX, MIN AND INCREMENT OF JUNCTION TEMPERATURE - DEG C  
?110,0,5

# DIGITAL MICROCIRCUITS

JK FLIP-FLOP

ENVIRONMENT CODE = 3

COMPLEXITY FACTOR = 3

QUALITY GRADE = AVERAGE GRADE

JUNCT TEMP	BASE FAIL RATE	FAIL RATE (%/1000 HRS)
0	2.16529E-04	3.69753E-02
5	2.51922E-04	4.53460E-02
10	2.91537E-04	5.24766E-02
15	3.35674E-04	6.04214E-02
20	3.84639E-04	6.92350E-02
25	4.38736E-04	7.89725E-02
30	4.98274E-04	8.96893E-02
35	5.63557E-04	0.101440
40	6.34892E-04	0.114281
45	7.12580E-04	0.128264
50	7.96922E-04	0.143446
55	8.88212E-04	0.159878
60	9.86740E-04	0.177613
65	1.09279E-03	0.196743
70	1.20665E-03	0.217196
75	1.32837E-03	0.239143
80	1.45883E-03	0.262590
85	1.59769E-03	0.287584
90	1.74538E-03	0.314169
95	1.90215E-03	0.342388
100	2.06823E-03	0.372282
105	2.24384E-03	0.403891
110	2.42918E-03	0.437252



EXAMPLE IV  
(CAPACITORS)

01/29/70

14:42

CAPACITOR FAILURE RATE

DO YOU WISH INSTRUCTIONS -- YES OR NO?YES

THIS PROGRAM CALCULATES THE FAILURE RATE OF CAPACITORS IN  
ACCORDANCE WITH THE RADCR RELIABILITY NOTEBOOK (SEPT 1967).

INPUT REQUIREMENTS IF APPLICABLE

1 CAPACITOR TYPE AND CODE

CODE	TYPE
1	PAPER FOIL, PAPER MYLAR, PAPER, MYLAR-METALLIZED
2	MYLAR OR TEFLON
3	PLASTIC FILM (NON-METALLIC CASE)
4	POLYSTYRENE
5	TANTALUM FOIL
6	TANTALUM, WET SLUG
7	TANTALUM, SOLID, DIELECTRIC
8	ALUMINUM, WET FOIL
9	MICA, MOLDED
10	MICA, DIPPED
11	MICA, BUTTON
12	GLASS, PORCELAIN
13	CERAMIC LOW K
14	CERAMIC, HIGH K
15	VARIABLE, CERAMIC
16	VARIABLE, GLASS PISTON

2 ENVIRONMENT AND CODE

(1) LO, (2) SO, (3) GF, (4) GP, (5) AL,  
(6) GM, (7) AU, (8) SL, AND (9) M

3 RELIABILITY LEVELS AND CODES

(1) L, (2) M, (3) N, (4) R, (5) S

4 CASE DIMA & LENGTH (IN.)

5 CIRCUIT RESISTANCE (OHMS/VOLT)

6 CIRCUIT STYLE --- CY10, CY20, ETC.

7 CAPACITANCE (UUF)

8 MAX., MIN. AND INCREMENT OF STRESSES ---  
(STRESS RATIO AND OPERATING TEMPERATURE - DEG C)

NOTE: IF ONLY ONE VALUE IS TO BE ENTERED FOR A STRESS INPUT  
(THAT) VALUE FOR MAX, MIN AND INCREMENT

DO YOU WISH TO RUN --- YES OR NO?YES

INPUT ENVIRONMENT CODE? 5

INPUT CAPACITOR TYPE CODE? 11

ANALYSIS FOR (1) UPPER OR (2) LOWER QUALITY GRADE ?  
INPUT 1 OR 2? 2

INPUT MAX, MIN AND INCREMENT OF STRESS RATIO? 6, 0, .3

INPUT MAX, MIN AND INCREMENT OF OPER. TEMPERATURE (DEGREES C)? 140, 0, 40

.....

#### NICA, BUTTON CAPACITOR

ENVIRONMENT CODE = 5

LOWER GRADE

STRESS RATIO = 0

TEMPERATURE ° C	FAILURE RATE (%/1000HRS.) L(B)	L(P)
0	6.56250E-04	3.33300E-02
40	6.85113E-04	4.84045E-02
80	1.86274E-03	7.03096E-02
120	4.55641E-03	0.189256

STRESS RATIO = 0.3

TEMPERATURE ° C	FAILURE RATE (%/1000HRS.) L(B)	L(P)
0	9.35950E-04	4.44380E-02
40	1.05852E-03	5.73408E-02
80	2.25046E-03	9.70183E-02
120	6.47864E-03	0.266146

STRESS RATIO = 0.6

TEMPERATURE ° C	FAILURE RATE (%/1000HRS.) L(B)	L(P)
0	2.87984E-03	0.122194
40	3.67237E-03	0.161895
80	6.92448E-03	0.283979
120	1.99343E-02	0.804372

ANOTHER ANALYSIS -- YES OR NO?YES

SAME ENVIRONMENT -- YES OR NO?NO

INPUT ENVIRONMENT CODE?3

INPUT CAPACITOR TYPE CODE?13

ANALYSIS FOR (1) UPPER OR (2) LOWER QUALITY GRADE ?  
INPUT 1 OR 2?1

INPUT MAX, MIN AND INCREMENT OF STRESS RATIO?0.0,0.1

INPUT MAX, MIN AND INCREMENT OF OPER. TEMPERATURE (DEGREES C)?0,120,-40

\*\*\*\*\*

#### CERAMIC LOW K CAPACITOR

ENVIRONMENT CODE = 3

UPPER GRADE

STRESS RATIO = 0

TEMPERATURE ° C	FAILURE RATE (%/1000HRS.)	
	L(B)	L(P)
120	2.42447E-03	9.71787E-03
80	4.89492E-04	1.97797E-03
40	9.88867E-05	4.15387E-04
0	1.99522E-05	9.98118E-05

STRESS RATIO = 0.10

TEMPERATURE ° C	FAILURE RATE (%/1000HRS.)	
	L(B)	L(P)
120	2.51426E-03	1.00771E-02
80	5.07621E-04	2.05048E-03
40	1.02487E-04	4.29948E-04
0	2.06917E-05	1.02767E-04

STRESS RATIO = 0.2

TEMPERATURE ° C	FAILURE RATE (%/1000HRS.)	
	L(B)	L(P)
120	3.14053E-03	1.25913E-02
80	6.34526E-04	2.55810E-03
40	1.26109E-04	5.32435E-04
0	2.58647E-05	1.23459E-04

## APPENDIX

### PROGRAM INSTRUCTION LISTINGS

THIS APPENDIX PRESENTS LISTINGS OF THE PROGRAM INSTRUCTIONS AS DISCUSSED IN SECTION III, 2, OF THIS REPORT.

## FAILURE RATES FOR CARBON COMPOSITION RESISTORS

### INSTRUCTIONS

THIS PROGRAM CALCULATES THE BASE FAILURE RATE AND THE CATASTROPHIC FAILURE RATE FOR THE FIRST PERIOD OF LONGEVITY AND A MULTIPLE OF THE FIRST PERIOD OF LONGEVITY FOR CARBON COMPOS. RES. IN ACCORDANCE WITH THE RADG RELIABILITY NOTEBOOK, SEPT. 1967.

#### INPUT REQUIREMENTS

1. RESISTOR STYLE
2. RESISTANCE VALUE (OHMS)
3. ENVIRONMENT -- LABORATORY, GROUND, ETC..
4. THE MULTIPLE OF LONGEVITY AND THE VALUE OF  $P(t)$  IF THE FAILURE RATE FOR A MULTIPLE OF LONGEVITY IS TO BE CALCULATED
5. STRESS CONDITIONS
  - A. STRESS RATIO = OPERATING POWER/POWER RATING  
MAX. MIN AND INCREMENT
  - B. OPERATING TEMPERATURE (DEGREES C)  
MAX. MIN. AND INCREMENT

#### NOTES:

THE ONLY INPUT TO THE PROGRAM THAT IS REQUIRED FROM THE NOTEBOOK IS THE VALUE OF THE  $P(t)$  FOR LONGEVITY  
THE REST OF THE ABOVE INPUTS ARE CODED IN THE PROGRAM

IF ONLY ONE VALUE IS TO BE ENTERED FOR A STRESS CONDITION  
INPUT THE VALUE FOR MAX. MIN. AND INC --- EXAMPLE 1,1,1

MANY OUTPUTS ARE CODED IN ACCORDANCE WITH THE INPUT CODES

THE INPUTS ARE ENTERED BY THE KEYBOARD AS THEY ARE QUERIED

## FAILURE RATE FOR FILM RESISTORS

### INSTRUCTIONS

THIS PROGRAM CALCULATES THE BASE FAILURE RATE AND THE CATASTROPHIC FAILURE RATE FOR THE FIRST PERIOD OF LONGEVITY AND A MULTIPLE OF THE FIRST PERIOD OF LONGEVITY FOR FILM RESISTORS IN ACCORDANCE WITH THE RADC RELIABILITY NOTEBOOK, SEPT. 1967.

### INPUT REQUIREMENTS

1. RESISTOR TYPE -- POWER, PRECISION, ESTABLISHED RELIABILITY OR INSULATED
2. RESISTANCE VALUE
3. ENVIRONMENT -- LABORATORY, GROUND, ETC.
4. MULTIPLE OF LONGEVITY AND P(L)
5. RELIABILITY LEVEL
6. RESISTOR CHARACTERISTIC
7. RESISTOR POWER (WATTS)
8. MAX, MIN AND INC OF THE STRESS RATIO AND OPER. TEMPERATURE  
STRESS RATIO = OPERATING POWER/RATED POWER

### NOTES

THE ONLY INPUT TO THE PROGRAM THAT IS REQUIRED FROM THE NOTEBOOK IS THE VALUE OF THE P(L) FOR LONGEVITY  
THE REST OF THE ABOVE INPUTS ARE CODED IN THE PROGRAM

MANY OF THE OUTPUTS ARE CODED IN ACCORDANCE WITH THE INPUTS

IF ONLY ONE ENTRY IS REQUIRED FOR THE STRESS RATIO OR THE OPER TEMPERATURE INPUT THE SAME VALUE FOR MAX, MIN AND INC

## FAILURE RATE FOR FIXED WIREWOUND RESISTORS

### INSTRUCTIONS

THIS PROGRAM CALCULATES THE BASE FAILURE RATE AND THE CATASTROPHIC FAILURE RATE FOR THE FIRST PERIOD OF LONGEVITY AND A MULTIPLE OF THE FIRST PERIOD OF LONGEVITY OF WIREWOUND RESISTORS IN ACCORDANCE WITH THE RADG RELIABILITY NOTEBOOK, SEPT. 1967.

### INPUT REQUIREMENTS

1. RESISTOR TYPE -- ACCURATE OR POWER  
OR INSULATED
2. RESISTANCE VALUE
3. ENVIRONMENT -- LABORATORY, GROUND, ETC.
4. VALUE OF  $P(L)$  FOR MULTIPLE OF LONGEVITY
5. RELIABILITY GRADE -- UPPER OR LOWER
6. RESISTOR CHARACTERISTIC
7. MAX, MIN AND INCREMENT OF THE STRESS RATIO AND OPER TEMPERATURE  
STRESS RATIO = OPERATING POWER/RATED POWER

### NOTES

THE ONLY INPUT TO THE PROGRAM THAT IS REQUIRED FROM THE NOTEBOOK IS THE VALUE OF THE  $P(L)$  FOR LONGEVITY AND THE RESISTANCE STYLE -- EXAMPLE RW 70

THE REST OF THE ABOVE INPUTS ARE CODED IN THE PROGRAM

MANY OF THE OUTPUTS ARE CODED IN ACCORDANCE WITH THE INPUTS

IF ONLY ONE ENTRY IS REQUIRED FOR THE STRESS RATIO OR THE OPER TEMPERATURE INPUT THE SAME VALUE FOR MAX, MIN AND INC

## FAILURE RATES FOR POTENTIOMETERS

### INSTRUCTIONS

THIS PROGRAM CALCULATES THE BASE FAILURE RATE AND THE CATASTROPHIC FAILURE RATE FOR THE FIRST PERIOD OF LONGEVITY AND A MULTIPLE OF THE FIRST PERIOD OF LONGEVITY FOR POTENTIOMETERS IN ACCORDANCE WITH THE RADG RELIABILITY NOTEBOOK, SEPT. 1967.

#### INPUT REQUIREMENTS

ENVIRONMENT - LABORATORY, SATELLITE ORBIT, ETC.

APPLIED VOLTAGE, RATED VOLTAGE, RESISTANCE (OHMS)

NUMBER OF TAPS, NUMBER OF SECTIONS, GANG - FIRST, SECOND, ETC.

AND THE VALUE OF  $P_i(\text{EFF})$  F IN ACCORDANCE WITH STEP 3

PAGE 78 OF THE NOTEBOOK

#### NOTES:

THE USER IS GIVEN THE OPTION OF INPUTTING OR HAVING THE STRESS RATIO CALCULATED BY THE COMPUTER

THE NUMBER OF SECTIONS AND THE VALUE OF  $P_i(\text{EFF})$  IS NOT REQUIRED IF THE ADJUSTED STRESS RATIO HAS BEEN PREASSIGNED.

MANY OF THE OUTPUTS ARE CODED IN ACCORDANCE WITH THE INPUT CODES

IF ONLY ONE VALUE FOR A GIVEN STRESS CONDITION IS DESIRED INPUT THAT VALUE FOR MAX, MIN AND INCREMENT



02/03/78

15:54

# CAPACITOR FAILURE RATE

DO YOU WISH INSTRUCTIONS -- YES OR NO?YES

THIS PROGRAM CALCULATES THE FAILURE RATE OF CAPACITORS IN  
ACCORDANCE WITH THE RADG RELIABILITY NOTEBOOK (SEPT 1967).

## INPUT REQUIREMENTS IF APPLICABLE

### 1 CAPACITOR TYPE AND CODE

CODE

TYPE

1	PAPER FOIL, PAPER MYLAR, PAPER, MYLAR-METALLIZED
2	MYLAR OR TEFLON
3	PLASTIC FILM (NON-METALLIC CASE)
4	POLYSTYRENE
5	TANTALUM FOIL
6	TANTALUM, WET SLUG
7	TANTALUM, SOLID, DIELECTRIC
8	ALUMINUM, WET FOIL
9	MICA, MOLDED
10	MICA, DIPPED
11	MICA, BUTTON
12	GLASS, PORCELAIN
13	CERAMIC LOW K
14	CERAMIC, HIGH K
15	VARIABLE, CERAMIC
16	VARIABLE, GLASS PISTON

### 2 ENVIRONMENT AND CODE

(1) LO, (2) SO, (3) GF, (4) GP, (5) AI,  
(6) GM, (7) AU, (8) SL, AND (9) N

### 3 RELIABILITY LEVELS AND CODES

(1) L, (2) M, (3) N, (4) R, (5) S

### 4 CASE DIM & LENGTH (IN.)

### 5 CIRCUIT RESISTANCE (OHMS/VOLT)

### 6 CIRCUIT STYLE --- CY10, CY20, ETC.

### 7 CAPACITANCE (UUF)

### 8 MAX., MIN. AND INCREMENT OF STRESSES --- (STRESS RATIO AND OPERATING TEMPERATURE - DEG C)

NOTE: IF ONLY ONE VALUE IS TO BE ENTERED FOR A STRESS INPUT  
(THAT) VALUE FOR MAX, MIN AND INCREMENT

DO YOU WISH TO RUN --- YES OR NO?

## CONNECTOR FAILURE RATE

### INSTRUCTIONS

THIS PROGRAM CALCULATES THE BASE FAILURE RATE AND THE FAILURE RATE OF CONNECTORS IN ACCORDANCE WITH THE RADC RELIABILITY NOTEBOOK, SEPT 1967.

#### INPUT REQUIREMENTS AND CODES

- 1 ENVIRONMENT  
(1) LABORATORY, (2) GROUND, FIXED, (3) GROUND PORTABLE  
(4) GROUND, MOBILE, (5) AIRBORNE, INHABITED,  
(6) AIRBORNE, UNINHABITED, (7) SATELLITE ORBIT  
(8) SATELLITE LAUNCH, (9) MISSILE
- 2 CONNECTOR IDENTIFIER  
(ONLY FOR IDENTIFICATION -- NOT USED FOR CALCULATIONS)
- 3 RELIABILITY GRADE -- UPPER OR LOWER
- 4 MATERIAL -- (1) A, (2) B, (3) C, (4) D
- 5 EXPECTED CURRENT (AMPS)
- 6 NUMBER OF ACTIVE PINS
- 7 CYCLES/1000 HRS.
- 8 MAX. MIN AND INCREMENT OF AMBIENT TEMPERATURE  
(DEGREES C)
- 9 PIN GAGE -- (1) 22, (2) 20, (3) 16, (4) 12

#### NOTES:

CODES = NUMBERS IN BRACKETS ( )

IF ONLY ONE VALUE FOR AMBIENT TEMPERATURE IS TO ENTERED, INPUT THAT VALUE FOR MAX, MIN AND INCREMENT

INPUTS TO THIS PROGRAM ARE ENTERED THROUGH THE KEYBOARD AS THEY ARE QUERIED.

MANY OUTPUTS ARE IN ACCORDANCE WITH THE INPUT CODES

## FAILURE RATES OF RELAYS

### INSTRUCTIONS

THIS PROGRAM CALCULATES THE BASE FAILURE RATE AND THE FAILURE RATE OF RELAYS IN ACCORDANCE WITH THE RADG RELIABILITY NOTEBOOK (SEPT 1967).

### INPUT REQUIREMENTS AND CODES

- 1 ENVIRONMENT
  - (1) LABORATORY (2) SATELLITE ORBIT
  - (3) GROUND FIXES (4) GROUND PORTABLE
  - (5) AIRBORNE INHABITED (6) GROUND MOBILE
  - (7) AIRBORNE UNINHABITED (8) SATELLITE LAUNCH
  - (9) MISSILE
- 2 CONTACT FORM AND QUANTITY
  - (1) SPST (2) DPST (3) SPDT
  - (4) 3PST (5) 4PST (6) DPDT
  - (7) 3PDT (8) 4PDT (9) 6PDT
- 3 PART IDENTIFIER  
(ONLY FOR PART IDENTIFICATION - NOT USED IN CALCULATIONS)
- 4 GRADE OF RELIABILITY -- (1) UPPER (2) LOWER
- 5 CYCLES/HR
- 6 LOAD TYPE - (1) RESISTIVE (2) INDUCTIVE  
(3) LAMP
- 7 TEMPERATURE RATING - (1) 85 OR (2) 125 DEGREES
- 8 MAX, MIN AND INCREMENT OF STRESS RATIO -  
(LOAD/RATED RESISTANCE LOAD)
- 9 MAX, MIN AND INCREMENT OF OPERATING TEMPERATURE

### NOTES:

IF ONLY ONE VALUE IS TO BE ENTERED FOR A STRESS INPUT  
THAT VALUE FOR MAX, MIN AND INCREMENT OF THE STRESS

MANY OF THE OUTPUTS ARE IN ACCORDANCE WITH THE INPUT CODES

## FAILURE RATES FOR SWITCHES

### INSTRUCTIONS

THIS PROGRAM CALCULATES THE FAILURE RATE OF SWITCHES IN ACCORDANCE WITH THE RADC RELIABILITY NOTEBOOK, SEPT. 1967.

#### INPUT REQUIREMENTS AND CODES

- 1 ENVIRONMENT & CODE  
(1) LABORATORY, (2) SATELLITE ORBIT, (3) GROUND FIXED  
(4) GROUND PORTABLE, (5) AIRBORNE INHABITES,  
(6) GROUND MOBILE, (7) SATELLITE LAUNCH
- 2 RELIABILITY GRADE -- (1) UPPER, (2) LOWER OR (3) BOTH
- 3 MAX., MIN. AND INCREMENT OF SWITCHING CYCLES/HR.
- 4 SWITCH DESCRIPTION -- (1) TOGGLE OR PUSHBUTTON  
(SINGLE BODY), (2) BASIC SENSITIVE SWITCH  
(SINGLE BODY OR MULTIPLE GROUPS),  
(3) ACTUATION ASSEMBLY (USING BASIC SENSITIVE  
SWITCH OR ROTARY WAFERS), (4) ROTARY SWITCH WAFERS
- 5 SWITCH TYPE - 1 SNAP ACTION, 2 NON-SNAP ACTION  
3 ACTUATION DIFFERENTIAL  $>.002$  IN.,  
4 ACTUATION DIFFERENTIAL  $<.002$  IN.,  
5 CERAMIC RF WAFERS, 6 MEDIUM POWER WAFERS
- 6 NUMBER OF CONTACTS, ACTIVE SWITCHES OR  
BASIC SENSITIVE SWITCHES.

#### NOTES:

THE NUMBERS IN BRACKETS (X) ARE THE CODES.

THE CODES FOR THE SWITCH TYPE ARE NOT CONSTANT FOR EVERY RUN

IF ONLY ONE VALUE IS TO BE ENTERED FOR THE CYCLES/HR.  
INPUT THAT VALUE FOR MAX, MIN AND INCREMENT

MANY OF THE OUTPUTS ARE IN ACCORDANCE WITH THE INPUT CODES.

## SEMICONDUCTOR FAILURE RATE

### INSTRUCTIONS

THIS PROGRAM CALCULATES THE BASE AND CATASTROPHIC FAILURE RATE OF SEMICONDUCTORS IN ACCORDANCE WITH THE RADCR RELIABILITY NOTEBOOK, VOL II, SEPT., 1967.

#### INPUT REQUIREMENTS AND CODES

- 1 ENVIRONMENT
  - (1) LABORATORY (2) SATELLITE ORBIT
  - (3) GROUND FIXED (4) GROUND PORTABLE
  - (5) AIRBORNE INHABITED (6) GROUND MOBILE
  - (7) AIRBORNE UNINHABITED (8) SATELLITE LAB
  - (9) MISSILE
- 2 MODEL
  - (1) GENERAL TRANSISTOR, (2) FIELD EFFECT, (3) UNIJUNCTION
  - (4) DIODES AND RECTIFIERS, (5) ZENER DIODES,
  - (6) SILICON CONTROLLED RECTIFIERS (SCR)
  - (7) MICROWAVE DETECTORS AND MIXERS, AND
  - (8) VARACTOR AND STEP RECOVERY DIODES
- 3 PART TYPE
- 4 GRADE OF RELIABILITY -- (1) UPPER OR (2) LOWER
- 5 APPLICATION
- 6 CURRENT OR POWER RATING (WATTS/AMPS)
- 7 VOLTAGE STRESS (PERCENT)
- 8 MAX, MIN AND INCREMENT OF STRESS RATIO
- 9 MAX, MIN AND INCREMENT OF OPER TEMPERATURE

#### NOTES

PART TYPE, APPLICATION, AND CURRENT OR POWER RATING ARE CODED HOWEVER, THEY ARE NOT THE SAME FOR EACH MODEL, THUS THEY ARE NOT INCLUDED HERE-IN. THESE CODES SHOULD NOT GIVE THE USER ANY DIFFICULTY SINCE THEY ARE STRAIGHT FORWARD

IF ONLY ONE VALUE IS TO BE ENTERED FOR A STRESS, INPUT THAT VALUE FOR MAX, MIN AND INCREMENT.

## FAILURE RATE OF MICROCIRCUITS

### INPUT REQUIREMENTS

- 1 ENVIRONMENT  
(1) LABORATORY, (2) SATELLITE ORBIT, (3) GROUND FIXED,  
(4) GROUND PORTABLE, (5) GROUND MOBILE,  
(6) AIRBORNE INHABITED, (7) AIRBORNE UNINHABITED,  
(8) SATELLITE LAUNCH, (9) MISSILE
- 2 PART IDENTIFIER
- 3 NUMBER OF BASIC FUNCTIONS
- 4 OPEN VOLTAGE GAIN
- 5 NUMBER OF EXTRA OR SPECIAL INPUTS
- 6 NUMBER OF EXTRA OR SPECIAL OUTPUTS
- 7 TYPE OF PACKAGE
- 8 QUALITY GRADE
- 9 MAX. MIN AND INCREMENT OF JUNCTION TEMPERATURE

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Computer programs which enable the reliability engineer to mechanically apply the "RADG Reliability Notebook," Volume II, September 1967, in obtaining the failure rate of piece parts are presented.		

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